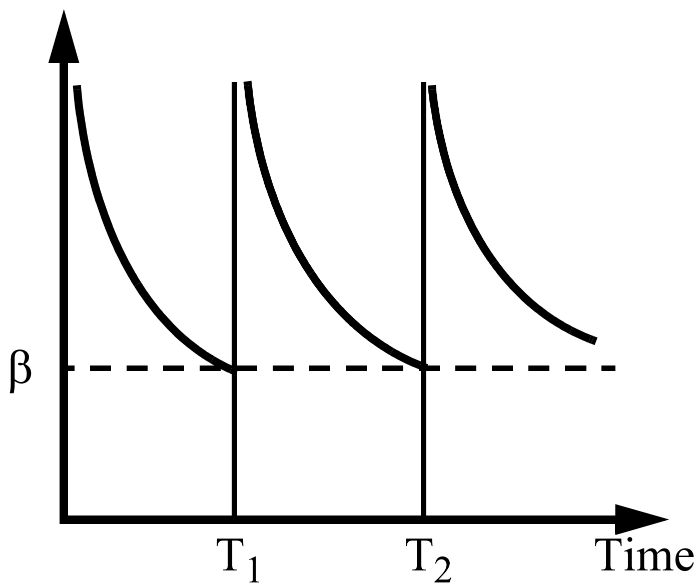
SESAM
USER MANUAL

Profast



Probabilistic Fatigue Analysis

DET NORSKE VERITAS

SESAM
User Manual

Profast

Probabilistic Fatigue Analysis

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Det Norske Veritas
Veritasveien 1
N-1322 Høvik
Norway

Telephone:	+47 67 57 99 00
Facsimile:	+47 67 57 72 72
E-mail, sales:	software.sesam@dnv.com
E-mail, support:	software.support@dnv.com
Website:	www.dnv.com

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1 INTRODUCTION

1.1 Profast - Probabilistic Fatigue Analysis

Profast is a tool for planning of inspection of - in particular - offshore jacket structures. It can also be used on other types of structures.

The main objective of Profast is to enable the user to reduce the cost of inspection of the structure for fatigue damage.

During the design phase Profast is used to design the structure for minimal inspection, and to efficiently plan the inspection of the structure after installation.

During the operational phase Profast is used to update the inspection plan with results from already executed inspections, in order to efficiently use the information gained and minimize the future inspection costs.

Profast allows efficient modelling of critical hotspots with related load and geometry data. Deterministic and probabilistic SN analysis can then be performed, as well as crack growth analysis based on a flexible crack growth model formulation. Inspection results can simply be assigned to the individual critical hotspots.

1.2 Profast in the SESAM System

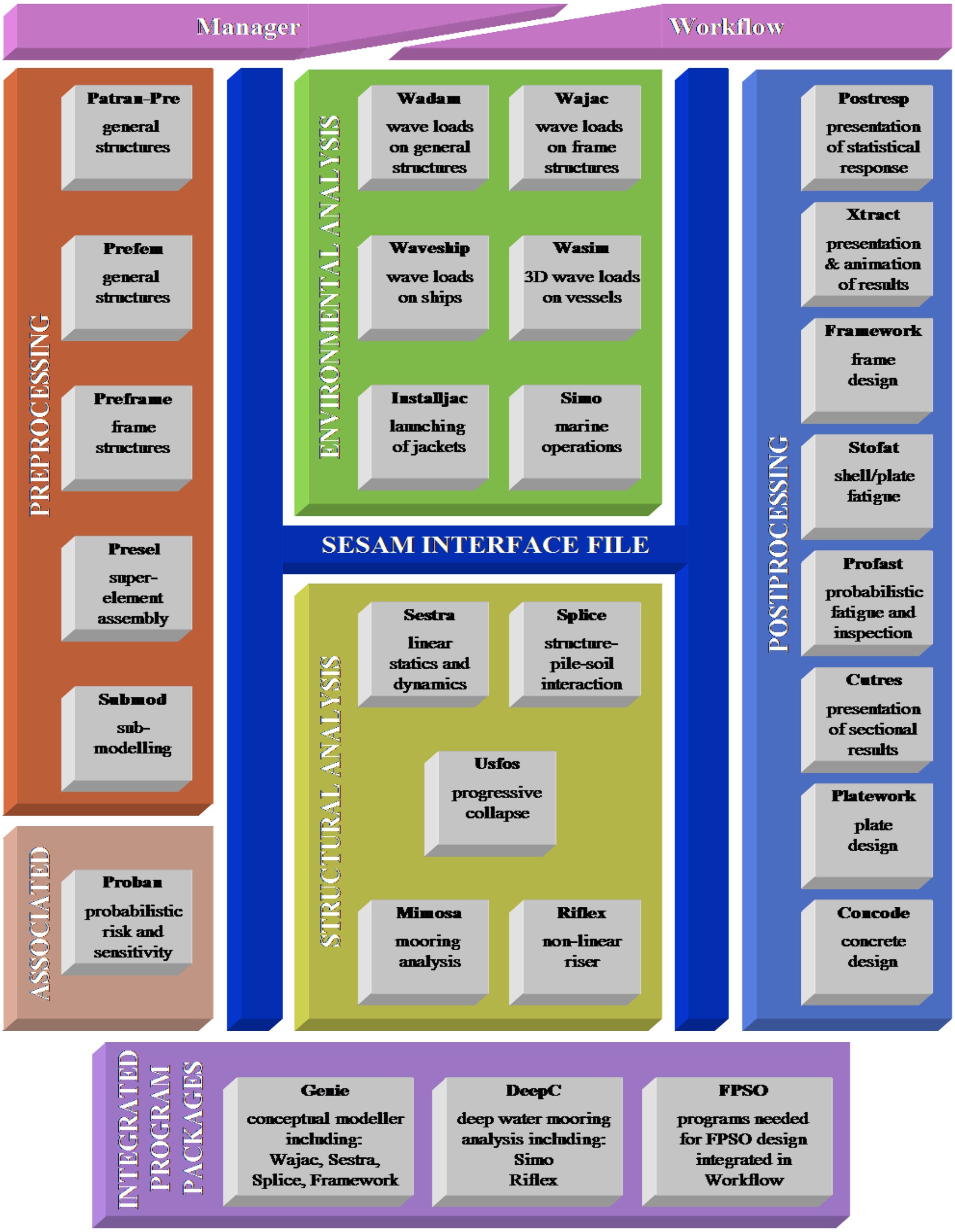


Figure 1.1 SESAM overview

SESAM is comprised of preprocessors, environmental analysis programs, structural analysis programs and post processors. An overview of SESAM is shown in Figure 1.1

Structures may be modelled by use of the SESAM preprocessors, subjected to wave loads by use of Wajac or Wadam, then subjected to structural analysis by use of Sestra (or similar solver program). The result is a Results Interface File (.SIN file).

This interface file may be read by Framework and used to identify those hotspots most prone to fatigue failure, and to establish parametric stress concentration factors.

Profast may then be used to do an in-depth inspection analysis of the critical hotspots. Profast makes direct usage of the structure and results established by Framework. It will not be necessary to enter the same data twice into Framework and Profast.

The distribution models available are described in detail in SESAM User's Manual: Proban Distributions, DNV SESAM Report NO.94-7089/Rev 1, June 1996

The theory is described in detail in SESAM Theory Manual: Profast No. 95-7005/Rev 3, 01 November 1996.

1.3 How to Read this Manual

Chapter 2 FEATURES OF PROFAST describes what the program can do.

Chapter 3 USERS'S GUIDE TO PROFAST contains guidance on how to exploit the features of Profast.

Chapter 4 EXECUTION OF PROFAST describes how to start the program and how to navigate the user interface. It also describes the files used by Profast and program requirements and limitations.

Chapter 5 COMMAND DESCRIPTION provides description of all commands and associated input data.

Appendix A TUTORIAL EXAMPLES contains a practical example on the usage of Profast.

Appendix B VARIABLES AND EVENTS MAINTAINED BY PROFAST are listed here.

2 FEATURES OF PROFAST

The overall scope of Profast is to be a practical, commercial engineering software tool for probabilistic fatigue analysis and inspection planning for jacket type offshore structures based on fatigue crack growth models.

Profast is integrated with the existing SESAM program Framework for code check and traditional fatigue analysis. However, it is not necessary to run Framework in order to use Profast.

The following sections describe the features of Profast in some detail.

2.1 Analysis Capabilities

Profast primarily provides the following four decision support results:

- Reliability at a hotspot wt. fatigue failure

  The reliability (or the failure probability) wt. fatigue failure as function of time based on either an S-N fatigue model or a Paris-Erdogan crack growth model is computed.

- Updated Reliability Result

  The reliability as function of time updated on basis of inspection findings and optionally repair.

- Inspection Planning - Prescribed Inspection Time

  For a given inspection quality, inspection (and possibly repair) history, predefined inspection intervals and a predefined reliability threshold, the joints necessary to inspect are identified. The procedure is based on the assumption that none of the inspections will find a crack.

- Inspection Planning - Optimised Inspection Time

  For a given inspection quality, inspection (and possibly repair) history and a predefined reliability threshold, the optimised time to next inspection is computed for a joint or a group of joints selected by the user.

In addition, a deterministic and probabilistic calculation of the S-N based fatigue life time and crack growth based life time may be performed.

The following figure describes the flow of information into Profast.

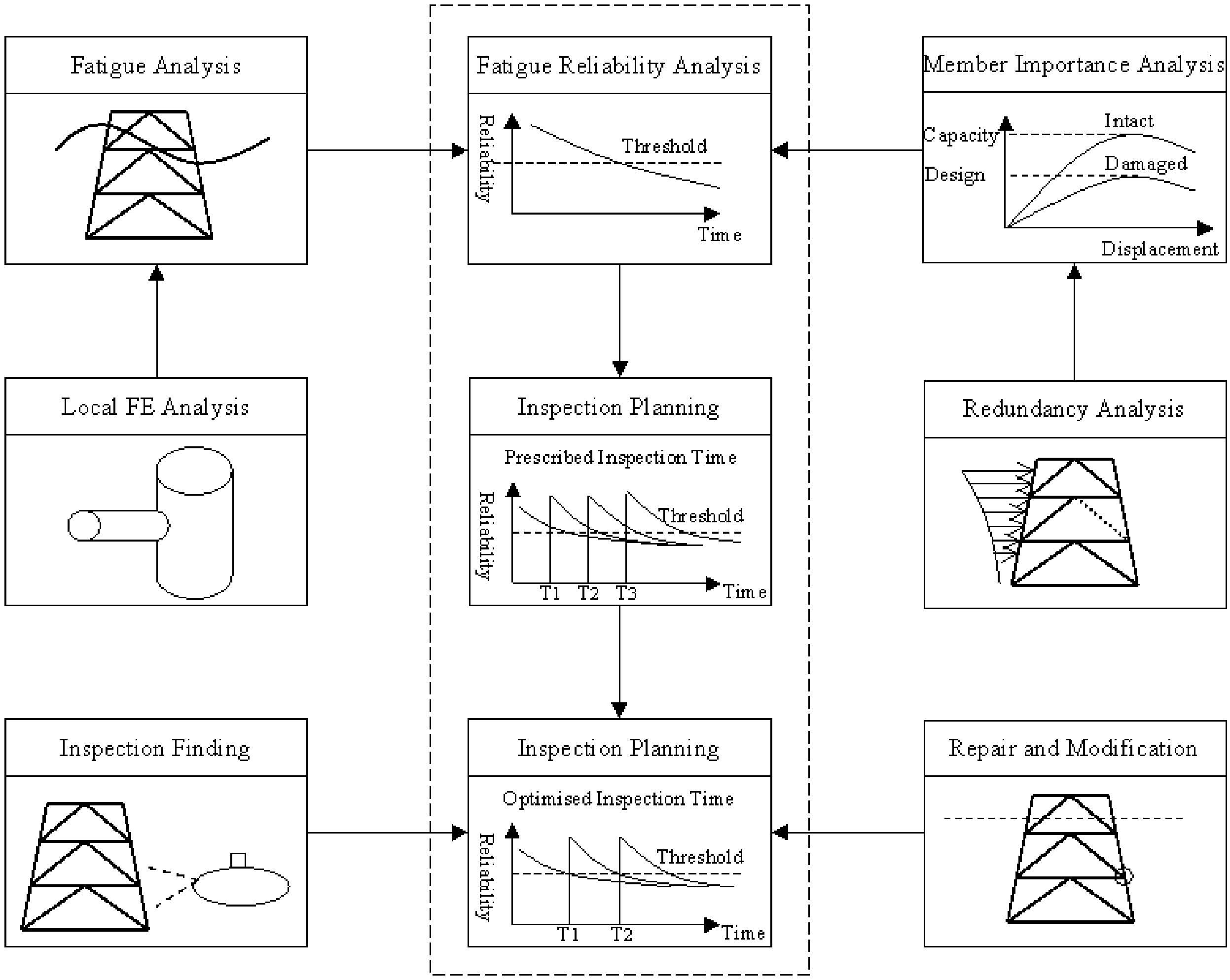


Figure 2.1 Flow of information into Profast

Profast is designed for probabilistic analysis of the reliability (or probability of failure) and for planning of inspections. Any other analysis results needed for this (transfer functions, member redundancy effects, selection of critical hotspots etc.) must be imported into Profast. When inspections have been performed, the probability of failure and the inspection plan may be updated as a consequence of the information gained.

2.2 Profast Environment

Profast may be run as a stand-alone program, or integrated in the SESAM system of programs.

2.2.1 Integration in SESAM

Inside the SESAM system, Profast may be seen as a post processor to Framework.

Framework is used first to define the jacket structure from the finite element description, calculate parametric stress concentration factors and identify the critical hotspots (other tools may also be used for this, e.g. Usfos).

Profast then takes over the database established by Framework, and thus may reuse all the data entered into Framework. Once Profast has opened the database, it becomes inaccessible to Framework. For this reason, it may be advisable to copy the database before running Profast.

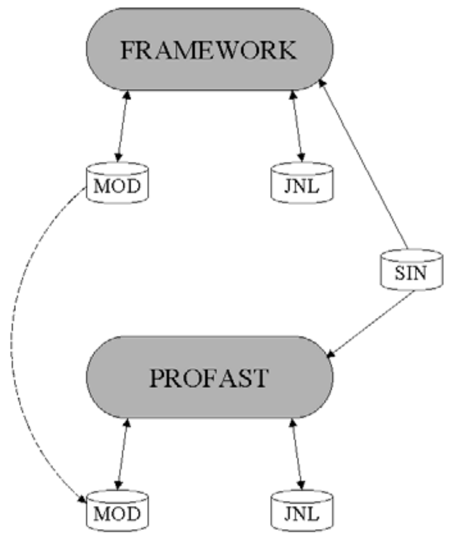


Figure 2.2 Integration between Profast and Framework

The SESAM Interface File is shared between the two programs, and must be available for Profast, when it is used by Framework. How to operate this integration is described in more detail in Section 4.1.6.

2.2.2 Terminology Clarification Between Framework and Profast

Please note that there is a possibility for some confusion in the terminology used by Profast and Framework.

In Framework, the terms "stochastic fatigue analysis" and "deterministic fatigue analysis" are used. The difference between the two basically refers to the way the environment is modelled, and both produce what in Profast would be termed a deterministic result (a single number).

In Profast, a deterministic SN analysis is comparable to a stochastic fatigue analysis in Framework, while a probabilistic analysis (sometimes the word stochastic analysis is also used) refers to an analysis that produce a probability or distribution as a result.

2.2.3 Profast as a Stand Alone Program

Profast may be also run alone, without access to a SESAM model and SESAM analysis results, and without access to Framework. Profast is self-contained, and is able to perform an inspection analysis and inspection planning on user defined points in a structure.

In such a case the following must be observed:

1 The user must supply all needed data by command input (interactively or through command input files)

2 It will not be possible to examine (print/display) the underlying structure, because Profast has no knowledge of this structure.

3 It will however be possible to open a SESAM Interface File (SIN file) and read transfer functions from this file.

2.3 Structural Modelling

When Profast is integrated in the SESAM system, the available structural model information will be automatically utilised. When run as a stand alone program, all required structural information must be supplied explicitly.

2.3.1 Selection of Hotspots for Inspection Analysis

A number of hotspots may be selected for inspection analysis, either positioned on joints or members, or unrelated to a structural geometry. In the latter case, all information (e.g. geometry) must be specified by the user.

The critical hotspots must be selected through the use of an outside tool, e.g. Framework (for SN-based fatigue analysis) and/or Usfos (for member importance analysis).

Those hotspots selected for analysis in Profast are denoted fatigue points. The word hotspot has been avoided in order not to conflict with the terminology used by Framework.

2.3.2 Transfer Function

Sectional force and moment transfer functions are available via the SIF/SIN files from analyses carried out by the engineer, provided that a stochastic fatigue analysis was performed during environment load calculation. They will be utilised directly when the fatigue point is positioned in a structure read from a Framework database.

It is also possible to manually define transfer functions (as a set of points, or read from a SIN file).

2.3.3 Stress Concentration Factor

The different stress concentration factors (SCFs) presently available in Framework are applicable to the probabilistic fatigue and crack growth analyses when the structure is modelled and analysed using SESAM.

Note that a correction factor is applied to the bending SCF values at hotspots 4, 10, 16 and 22 for PIPE elements, when the SCF distribution is either CROWN-SADDLE or PARAMETRIC. In Framework, this correction is applied during a fatigue check analysis, and does not show up in the printed output. In Profast this correction is applied when the SCF values are transferred into the Profast database, and thus will show up in the printed output. The SCF values will therefore in this case appear to be different in Framework and Profast. The correction has been applied in the data transfer to Profast in order to achieve the same deterministic fatigue life in Profast as is calculated using a stochastic fatigue analysis in Framework. The correction factor can be manipulated in Profast by use of the command DEFINE FATIGUE-CONSTANTS, but the change will only take effect for fatigue points created after it has been made.

Stress concentration factors can also be specified manually.

2.3.4 Stress Influence Function

It is possible to manually specify stress influence coefficients from separate, detailed finite element analyses of joints, for use with any fatigue points. In the case of fatigue points positioned in a model from Framework, this will override the default SCF assignment read from the database. In any case, the user must take responsibility for creating and associating the correct transfer functions with the influence coefficients. See also Section 3.5.2 and the Profast Theory Manual.

2.3.5 Geometry Function

The following geometry functions are available:

- Centre crack in panel.
- Edge crack in panel.
- Surface crack in finite width plate for length and depth.
- Circumferential surface crack in hollow cylinder for depth.
- Tubular K-joint (data fit)
- Constant geometry function.
- A general polynomial geometry function with user defined parameters.
- User defined geometry function fitted to a set of data points.
- User defined weld magnification factors (optional usage), to be multiplied on the geometry function.

A factor can be applied to the geometry function, and uncertainty can be applied to this factor (useful for defining uncertainty in the model itself). Uncertainty can also be applied to other geometry function parameters.

One dimensional geometry functions and the weld magnification factor can be displayed.

2.4 Environmental Loading

2.4.1 Environmental Description

The environment description consists of the following elements

1 A wave scatter diagram for each wave direction, with assigned wave spectrum shape (Pierson Moskowitz, Jonswap and General Gamma) and wave spreading function.

2 A probability distribution for the different wave directions.

The environmental description is identical to the one used in Framework when performing a stochastic fatigue analysis.

The scatter diagram may be used as is, fitted to a bivariate lognormal distribution, or to a distribution described by Fang and Hogben. For more details, see the Profast Theory manual.

2.4.2 Long Term Stress Distribution

The long term stress range distribution may be specified as one of the following

1 As a constant value, with optional uncertainty.

2 As a Weibull distribution with specification of ln(A) (the logarithm of the scale parameter) and 1/B (the reciprocal of the shape parameter). Both these parameters can be uncertain.

3 As a sum of Rayleigh distributions, based on the environmental and force description.

4 As a Weibull fit to the sum of Rayleigh distributions.

The calculation of the Sum-Rayleigh distribution is described in the Profast Theory Manual. In the first two cases, the number of load cycles per second must also be specified (it is calculated automatically in the latter cases). This value can be uncertain.

2.5 Fatigue and Crack Growth Model

2.5.1 Fatigue Model

An S-N fatigue model based on Miner's Rule is available. S-N curves are picked from a list of alternatives or specified manually by the user. It is not possible to update the SN-analysis based on inspection results, or to use the SN-analysis to prepare an inspection plan.

The following SN-curves are predefined in Profast. Note that the stress is in N/m^2. However, when imported from Framework, these curves can be used with a model in different units provided that the E modulus is equivalent to 2.1*10^{11} N/mm^2, as the stress will automatically be scaled to the proper size by using the size of the E modulus in the units actually used. Note that this unit conversion only applies to the predefined SN curves.

Table 2.1 Predefined SN-curves

Name	Description	m_0	S_0 (N/m^2)	N_0	$loga_0$	$logk_0$	$Std(lk_0)$
DNV-X	Det Norske Veritas X-curve	4.1	$34.000*10^6$	$2*10^8$	39.1800	39.9800	0.4000
NS-B-SEA	NS 3472 B-curve sea cathodic	4.0	$47.437*10^6$	$2*10^8$	39.0055	39.3697	0.1821
NS-C-SEA	NS 3472 C-curve sea cathodic	3.5	$33.221*10^6$	$2*10^8$	34.6260	35.0342	0.2041
NS-D-SEA	NS 3472 D-curve sea cathodic	3.0	$19.659*10^6$	$2*10^8$	30.1817	30.6007	0.2095
NS-E-SEA	NS 3472 E-curve sea cathodic	3.0	$17.299*10^6$	$2*10^8$	30.0151	30.5169	0.2509
NS-F-SEA	NS 3472 F-curve sea cathodic	3.0	$14.671*10^6$	$2*10^8$	29.8004	30.2370	0.2183
NS-F2-SE	'NS 3472 F2-curve sea cathodic	3.0	$12.914*10^6$	$2*10^8$	29.6342	30.0900	0.2279
NS-G-SEA	NS 3472 G-curve sea cathodic	3.0	$10.738*10^6$	$2*10^8$	29.3939	29.7525	0.1793
NS-T-SEA	NS 3472 T-curve sea cathodic	3.0	$19.390*10^6$	$2*10^8$	30.1638	30.6606	0.2484
NS-W-SEA	NS 3472 W-curve sea cathodic	3.0	$9.233*10^6$	$2*10^8$	29.1970	29.5662	0.1846
API-X	API X-curve	4.38	$35.000*10^6$	$2*10^8$	41.3440	41.3440	0.2838
API-XP	API X'-curve	3.74	$23.000*10^6$	$2*10^8$	35.8340	35.8340	None

Note that the predefined NS3472 curves are based on the values of logk (named loga in NS3472) and the standard deviation of this reported in NS3472 (NS3472 gives redundant information: the corresponding stress levels are also reported, but rounded to integer values. These stress levels have not been used).

The relationship between S_0, $\log_{10}(a_0)$, $\log_{10}(k_0)$ and the standard deviation of $\log_{10}(k_0)$ is, when a deterministic analysis is performed:

$S_0 = (\log_{10}(a_0)/N_0)(1/m0) = ((\log_{10}(k_0) - 2*Std(\log_{10}(k_0))/N_0)(1/m0)$

During a probabilistic analysis, $\log_{10}(k_0)$ follows a Normal distribution with the specified standard deviation.

See also Figure 3.9.

2.5.2 Crack Growth Model

The following crack growth models are available:

- Paris-Erdogan, one dimensional crack growth with optional stress amplitude threshold
- Paris-Erdogan, two dimensional crack growth with optional stress amplitude threshold
- Shang, simulated two dimensional crack growth with optional stress amplitude threshold. This model simulates two dimensional crack growth by varying the aspect ratio as a function of the crack depth.

2.5.3 Calibration of the Crack Growth Model

The crack growth model may be calibrated to the SN model, in such a way that the reliability results are close during the service life of the structure.

Up to three parameters in the crack growth model and up to five time points are selected, and the parameters modified iteratively until the reliability results from the SN analysis and the crack growth model are close.

2.5.4 Failure Criteria

For the S-N analysis, the failure criterion is that the Miner's Sum exceeds a user specified level.

For the crack growth model, the failure criteria is that

The crack depth exceeds a user specified critical value

or

The crack length exceeds a user specified critical value

2.6 Inspection Finding and Repair

The following inspection events are available:

1. No crack found, i.e. the inspection event is:

   The crack size at the inspection time is smaller than the smallest detectable crack size.

2. A crack of unknown size was found, i.e. the inspection event is:

   The crack size at the inspection time is greater than the smallest detectable crack size.

3. A crack was found to be equal to, less than or greater than a measured value (with optional uncertainty), i.e. the inspection event is:

   The crack size at the inspection time is identical to, less than or greater than the measured crack size.

For each finding, the inspection time must be specified. Inspections do not need to be specified in chronological order. Once specified, they can be deleted, but not changed.

Given that an inspection results in the finding of a crack, a decision on grind repair may be taken. In the case of grind repair, the grind depth must be specified and Profast then redefines the crack growth model and SN model from the time of the inspection.

An inspection is characterised by its inspection quality as defined by the Probability Of Detection (POD) curve, describing the smallest detectable crack size. A POD curve is modelled as a random variable. Some predefined POD curves exist (see Table 2.2, Figure 2.3 and Guideline for Offshore Structural Reliability Analysis, DnV Research Report No. 95-7003).

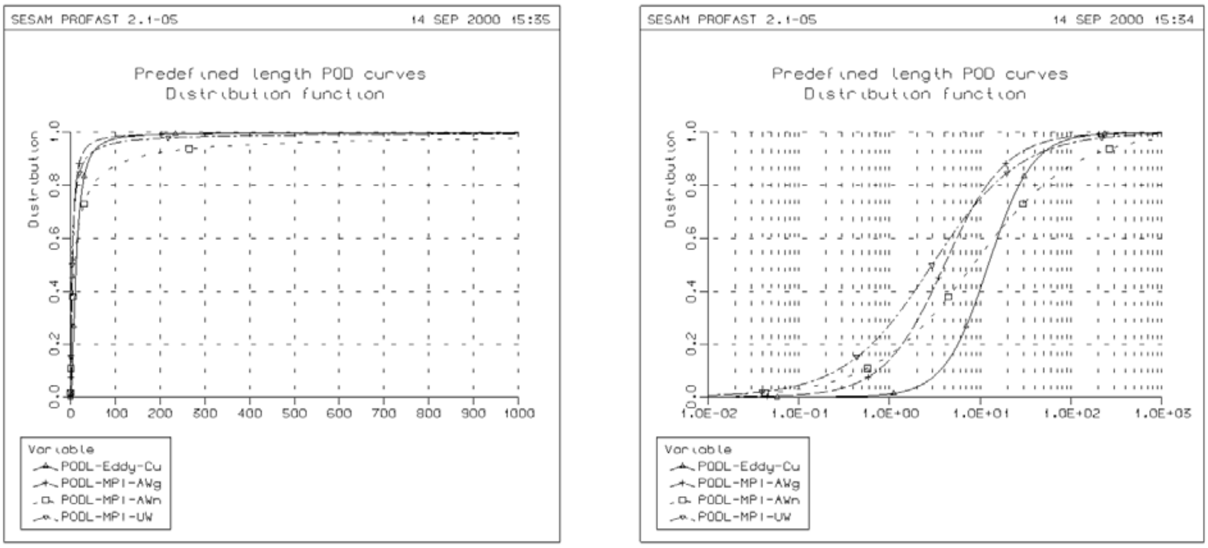


Figure 2.3 Predefined POD distributions — crack length in mm

These predefined curves are based on the distribution function:

$F(a) = P(A < a) = 1 - 1 / (1 + (a/x_0)^b)$

where a is the crack depth and x_0 and b are distribution parameters. This distribution is accessible under the name POD-Distrib, so it is possible to create other random variables using this distribution.

Table 2.2 Built-in POD curves for length inspection — crack length in mm

Name	x0	b	Description
PODL-MPI-UW	2.950	0.905	MPI Under Water
PODL-MPI-AWg	4.030	1.297	MPI Above Water, ground test surface
PODL-MPI-AWn	8.325	0.785	MPI Above Water, not ground test surface
PODL-Eddy-Cu	12.28	1.785	Eddy current

2.7 Inspection Planning

Once a crack growth model is defined, inspections can be planned. This is because the crack growth model incorporates observable information (the crack size) into the model, thus allowing the calculation of conditional probabilities based on the observed information.

2.7.1 Target Reliability

In order to be able to decide when inspections are needed, a reliability target value βtarget must be specified for each fatigue point. The reliability at each point is not allowed to go below this target value.

For a proper choice of the target reliability, appropriate rules, guidelines and design codes should be consulted. The choice of target reliability is not a subject for this manual, as it may involve evaluation of the different failure consequences (e.g. economical, loss of life).

2.7.2 Inspection Quality

When planning inspections over the whole service life, it is standard practice to assume that inspections will be performed in the future when needed, and with the result that no crack is found.

In order to be able to do this, an inspection quality (POD curve) to be used in the future must be defined. If this inspection quality is not defined, Profast will only be able to plan one inspection into the future.

2.7.3 Inspection Times

There are two ways in which the inspection times can be planned

- Prescribed times:

  The inspections are known to be performed at certain prescribed points in time. Thus, inspections will be planned such that the reliability of each fatigue point never falls below the target reliability.

- Optimised times:

  The inspections are not performed until the reliability is identical to the target reliability. This will typically require fewer inspections than the inspection at prescribed times, but require more flexibility in the execution of the inspections.

2.8 Uncertainty Modelling

2.8.1 General Description

Many of the input values in Profast may be assigned an uncertainty which is used in the probabilistic analyses.

Each of these stochastic input values (termed stochastic parameters in the following) is represented by a random variable, and has a default uncertainty assigned. The random variable is unique for each instance of the value (e.g. for each initial crack depth defined), but the uncertainty definition is the same for all stochastic parameters of the same type (e.g. for all initial crack depths).

The default uncertainty definition consists of default distribution, bound(s) of the distribution when needed, and when applicable a default set of uncertainties labelled low, medium and high. The user may specify that a stochastic parameter has, for example, low uncertainty, and the default distribution will then be applied with the default definition of what low uncertainty is.

It is possible to override the default distribution in one of three ways:

1 By specifying that the stochastic parameter has no uncertainty assigned.

2 By creating another random variable and using this instead.

3 By changing the default uncertainty definition for the stochastic parameter. This will affect all stochastic parameters based on the same uncertainty definition.

It is possible to correlate stochastic parameters by correlating the associated random variables.

All available stochastic parameters are documented with the individual commands in Chapter 5, and the default uncertainty for each parameter may be printed by use of the command:
PRINT UNCERTAINTY DEFINITION.

2.9 Analysis and Results

It is possible to run the following analyses types

- SN based fatigue analysis
- Calibration of crack growth model to SN fatigue result
- Crack growth analysis, with or without updating based on inspections
- Inspection planning
- Tailor made probability analyses

These analyses may produce one or more of the following results

- Deterministic life time
- Stochastic distribution of the life time
- Reliability (failure probability) as a function of time
- Inspection plan
- Sensitivities

2.9.1 Definition of the Reliability Index

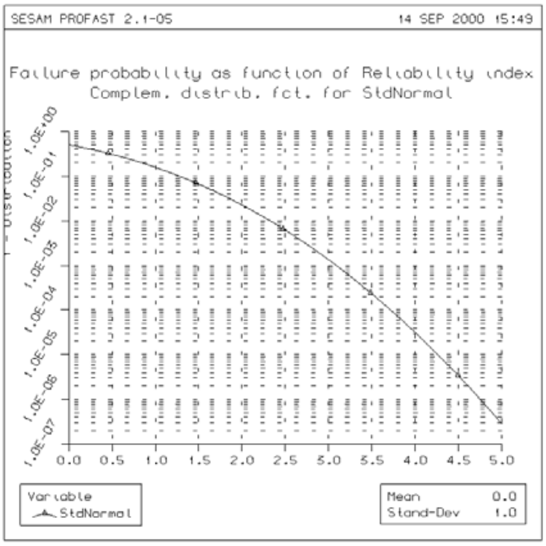


Figure 2.4 Correspondence between reliability index and failure probability

The term “reliability index” is used repeatedly during the Profast documentation. The reliability index (typically denoted β is in one-to-one correspondence with the failure probability p_f, and is defined as:

$$\beta = -\Phi^{-1}(p_f)$$

or equivalently

$$p_f = \Phi(-\beta)$$

where Φ is the Standard Normal distribution function.

The reliability index is increasing with increasing actual reliability and typical reliability index values are approximately in the range 1 to 7.

2.9.2 SN Based Fatigue Analysis

This analysis may be used to produce a deterministic or stochastic fatigue life, or produce the reliability as a function of time. It may be performed for the whole fatigue life, or from the time an inspection was performed.

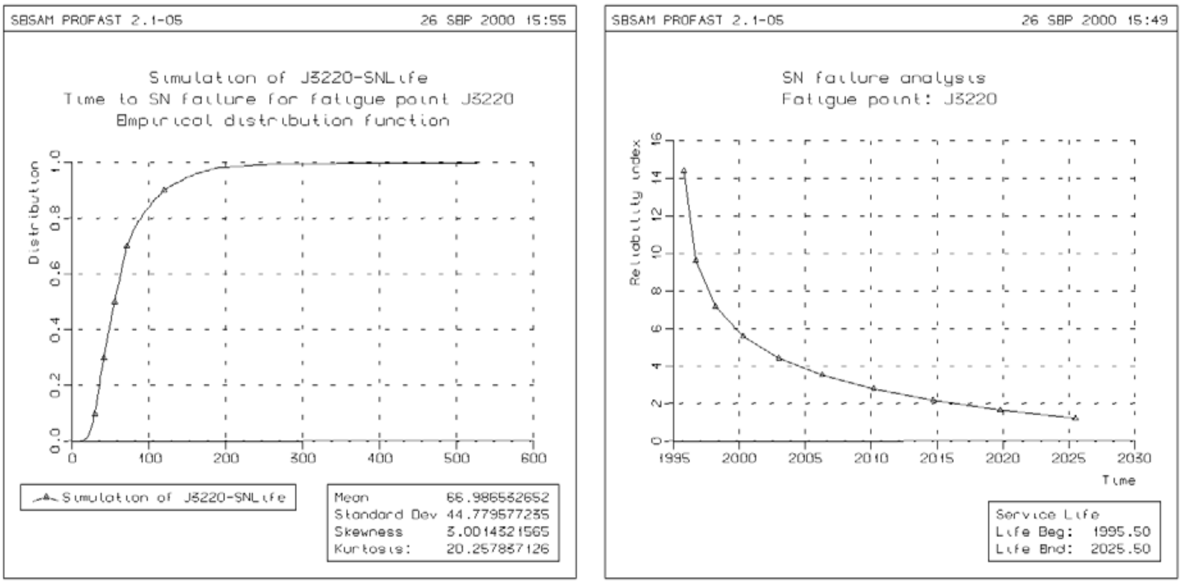


Figure 2.5 Results from SN fatigue analysis

Please note that the SN curve may be used differently in deterministic and probabilistic analysis, see Section 2.5.1.When there is uncertainty on the log(K) parameter in the SN curve, the deterministic fatigue life will be in the lower tail of the stochastic distribution, due to the fact that the deterministic analysis incorporates a safety factor on log(K).

By default, no sensitivity results are calculated during an SN failure probability analysis, in order to save computation time. This sensitivity calculation may be turned on if desired.

2.9.3 Calibration of Crack Growth Analysis to SN Fatigue Reliability

The calibration analysis is an iterative process, where the selected parameters are modified in order to produce a crack growth reliability result that matches the SN reliability result at the selected time points.

The result of the calibration and the iteration history may be printed and displayed. It has been observed, that the calibration produces a considerably better match for a two dimensional crack growth model than for a one dimensional model.

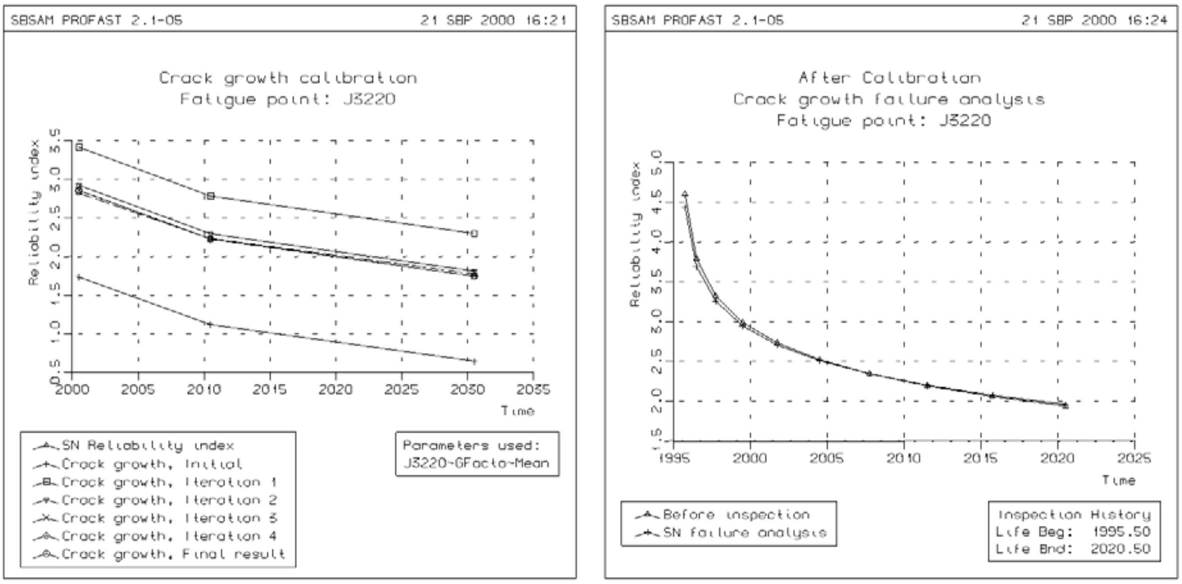


Figure 2.6 Result of crack growth calibration for a two dimensional crack growth model

2.9.4 Crack Growth Analysis

This analysis may be used to produce a deterministic or stochastic fatigue life, or to produce the reliability (failure probability) as a function of time. It may be performed from the start of the service life, or from the time an inspection was performed.

If an inspection exists after the start time of a failure probability analysis, the updating required at this inspection is automatically taken into account. The SN reliability curve may be shown with the crack growth reliability curve.

By default, no sensitivity results are calculated during a crack growth failure probability analysis, in order to save computation time. This sensitivity calculation may be turned on if desired.

Crack growth analysis results are presented in Figure 2.6 and Figure 2.7.

2.9.5 Inspection Planning

Inspection plans cannot be displayed by themselves. They can be printed point wise (i.e. fatigue point by fatigue point) or chronologically (in increasing order of time).

However, the planned future inspections may optionally be kept during the calculation of the plan, thus enabling the calculation and display of the predicted reliability of failure probability curve, as illustrated here:

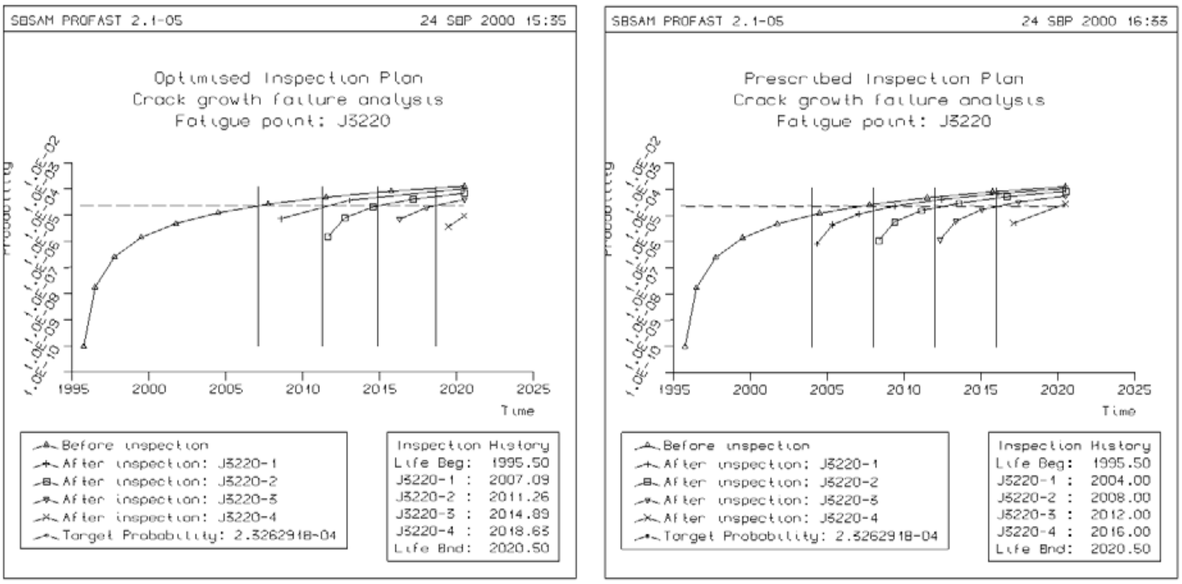


Figure 2.7 Crack growth failure curve according to prescribed and optimised inspection plan

2.9.6 Tailor made Probability Analysis

When Profast performs an SN or a crack growth analysis, it leaves a number of random variables and events, that have been used to perform the analysis. These are described in more detail in Chapter 3. These variables and events can be used to calculate probabilities and distributions, that are not otherwise directly accessible.

For example, the SN and crack growth failure analyses calculate the failure probability through a specified period of the service life. It is possible calculate the failure probability at the end of the service life only, by using the RUN PROBABILITY-ANALYSIS command on the variable FP-SNFail (for SN analysis) or FP-CGFail (for crack growth analysis), assuming that the fatigue point is named FP. This may be useful for examining sensitivities at the end of the service life without having to calculate them at a number of time points.

As a more advanced case, it is possible to condition the failure probability of one fatigue point (A) on an inspection of another point (B) by using the command: RUN PROBABILITY-ANALYSIS CONDITIONED A-CGFail B-INAll after a crack growth analysis of both A and B has been performed. The event B-INAll will contain all inspections performed at the point B.

2.9.7 Sensitivity Results

The probabilistic analysis may produce two kinds of sensitivity results:

- Parametric sensitivity

measures the change in a result (e.g. a probability of failure) resulting from a change in a parameter, e.g. the derivative of the result wt. the parameter. Parametric sensitivities are not dimensionless - the magnitude of the value will depend on the magnitude of the parameter.

- Importance factors

  measures the effect the uncertainty of a random variable has on the result. Importance factors sum up to 100%. Thus, if a variable has a very low importance factor, the effect on the result of treating the variable as a constant instead of random would most likely be negligible. On the other hand, if the importance factor of a variable is high, care should be taken in the modelling of the uncertainty of this variable.

Parametric sensitivities may be printed in tabular form or printed/displayed as a function of time when several analyses have been formed over time.

Importance factors may be presented similarly, and may also be displayed as a pie chart., see Figure 2.5.

A distribution analysis may only produce parametric sensitivities.

Please note that sensitivity results are turned off by default when doing SN and crack growth failure probability analysis.

3 USERS’S GUIDE TO PROFAST

This chapter describes the usage of Profast, with illustrating examples.

The analysis is divided into the following logical steps:

1 Preparations for analysis

2 Starting Profast

3 Definition of fatigue points

4 Environment, forces and load modelling

5 SN fatigue analysis

6 Crack growth analysis

7 Taking inspections into account

8 Planning future inspections

Each of these steps are described in detail in the following sections. In addition, there is a section about modelling of uncertainties, and a section on advanced use of Profast. At the end of the chapter, there is a section with various hints on how to facilitate the use of Profast.

An example is used to illustrate the steps. The example serves the purpose as a tutorial, although it is not a realistic example. It is based on the model shown in Figure 3.3. The command input files used are listed in Appendix A together with some results.

Command input examples and responses by Profast are shown using the Courier font with a slightly smaller size. An example:

```
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-OSCF ) MEDIUM
      Changed Variable J5120-OSCF to Normal( Mean-CoV: 3.53553, 5.0E-02)
```

3.1 Preparations for Analysis

Before a Profast analysis can begin, the critical hotspots are usually determined. This is not done by use of Profast, but rather through some other utility program, e.g. Framework (to find the deterministic fatigue life) or Usfos (for progressive collapse analysis or member redundancy analysis).

In addition, the resulting forces on the structure may have been analysed, e.g. by use of Wajac, Wadam and Sestra, producing a results interface file (.SIN file) with the structure analyses and transfer functions (the transfer functions require a stochastic fatigue analysis in Wajac or Wadam). This file may be used by Profast to model the long term stress range distribution.

If such a file is not available, the transfer functions should be made available in a format suitable for inclusion by the CREATE TRANSFER-FUNCTION command. See the description of this command in Chapter 5.

Profast may start up from a database produced by Framework (the .MOD file).This will allow Profast to use the information in this database, as well as in the SIN file attached to this database. It will also allow display of the Framework model by use of the DISPLAY MEMBER / JOINT / LABEL / SUPERELEMENT / PRESENTATION commands. If Profast is started from a Framework database, please read Section 4.1.6 first, in order to make sure that the transition is done in the best possible way. Also, check which units have been used in the imported model, in order to make sure that the input to Profast is specified in the correct units.

Finally, it is advisable to keep each structure being analysed in a separate directory on the disk, to ease maintenance of files.

In the tutorial example two critical points are located at each end of the same member, 31415 (see Appendix A for details).

3.2 Starting Profast

The start-up is described in more detail in Section 4.1.

When Profast is started, an opening dialog is presented (see Figure 3.1).

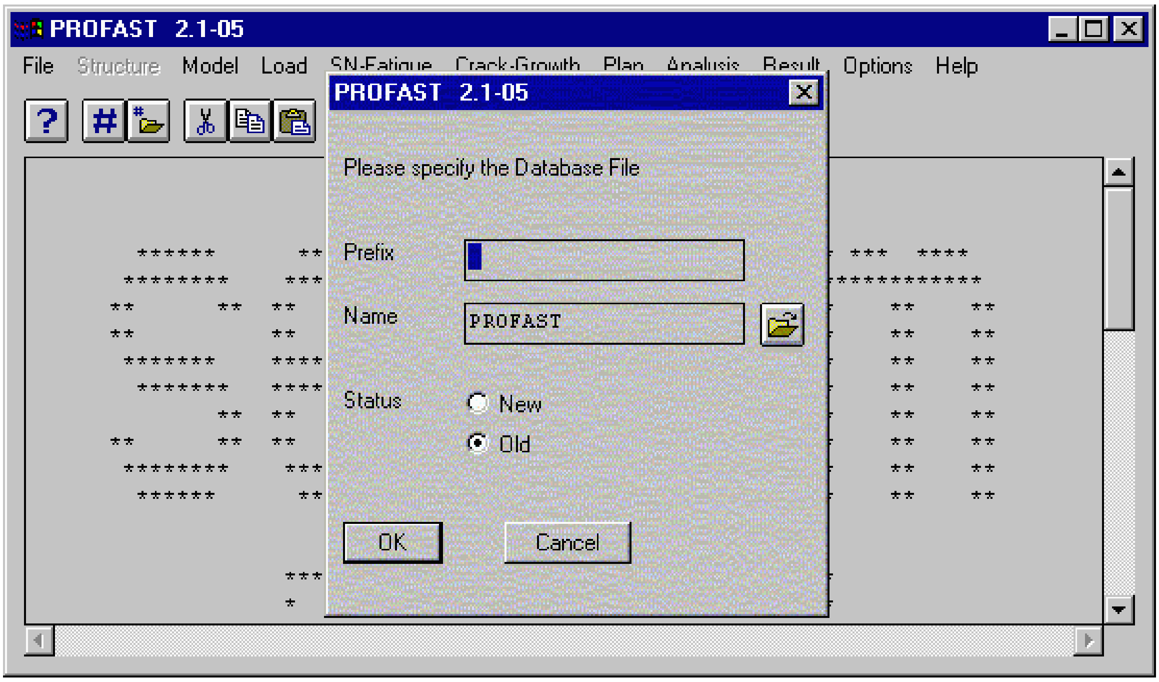


Figure 3.1 Profast start-up dialog

There are now two possible cases the first time Profast is started with a new model:

- A Framework model is to be used. In this case, the OLD alternative must be selected and the name and prefix of the model file specified. Note that it is recommended to copy the Framework model file to a file with another name and then use the copied file. This is because Framework may not open the database again once it has been opened by Profast, and because this will produce a journal file with a new name (Framework and Profast journals should not be mixed in the same file).
- No Framework model file is to be used. In this case, specify the name and prefix of the model file and select NEW.

If an existing Profast model file is to be opened, specify the name and prefix of the file and select OLD.

3.2.1 Navigating the User Interface

Profast has two different user interfaces:

- A line mode, text based interface suitable for typed commands and batch runs. This interface is described in detail in Section 4.4.
- A graphical user interface, suitable for interactive usage. This interface is described in detail in Section 4.5.

Both user interfaces journal the users actions in a file in the form of line mode commands. This file can be reused to re-establish the database (if needed) or as a concise description of the model.

The graphical user interface incorporates the line mode user interface, both as a command input line and as a command picker, which will allow using the mouse to pick commands instead of typing them.

The graphical user interface has a different setup than the command line interface. The line mode commands are action oriented, i.e. the command syntax usually starts with a verb and is followed by a noun. The graphical user interface presents a pull down menu system, where the menus are grouped according to subjects. In the modelling and analysis process the menus are generally used from left to right. This is also the case for the tutorial example used in this chapter.

3.2.2 Initialising the Database

When a database is opened for the first time, some initialisation needs to be done.

If required, default uncertainties and other defaults should be changed at this stage, e.g. by reading in a command input file with the settings preferred by your company.

The display device and plot format (if needed) should be checked in order to see if they match the required local settings.

The service life of the structure being analysed must be set using DEFINE SERVICE-LIFE. This includes setting a start time and final time in years for the structure.The service life is specified in years. The tutorial example exemplifies a jacket installed mid 1995 and with a 30 year life span:

```
DEFINE SERVICE-LIFE 1995.5 2025.5
```

The corresponding dialog box is found under the “Model” pull down menu:

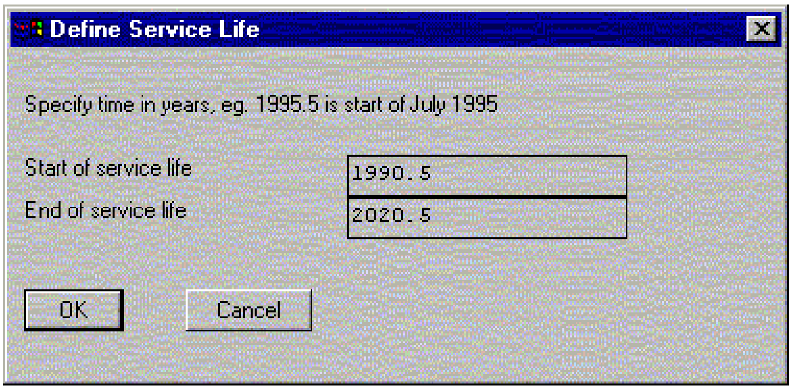


Figure 3.2 Dialog box for definition of the service file

If a Framework database is opened, the structure may be displayed if desired, to verify that the database is correctly transferred. The superelement, members and joints may be displayed. Members and joints may be displayed one by one, or as named sets predefined in Framework. These commands are available in the graphics user interface under the “Structure” pull down menu.

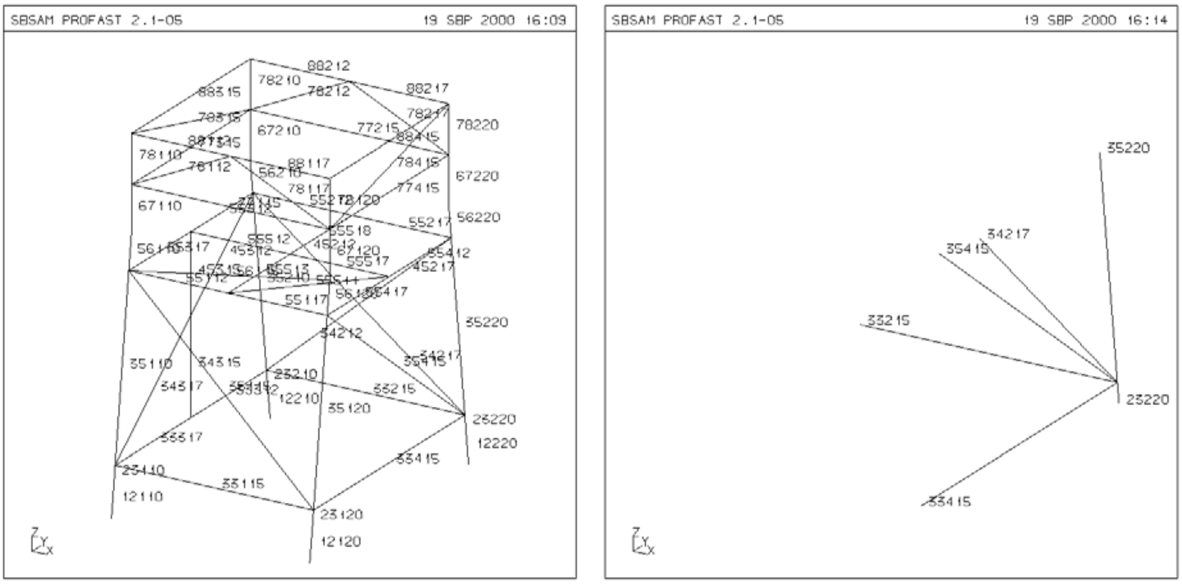


Figure 3.3 Display of all members and of joints 5120 and 3220

The plots have been created using the following commands:

```
SET DRAWING FONT-SIZE RELATIVE 1.5
DISPLAY MEMBER ALL
DISPLAY LABEL MEMBER-NAMES ON
DISPLAY JOINT CRITICAL                  % CRITICAL is a predefined set of joints
DISPLAY LABEL MEMBER-NAMES ON
DISPLAY LABEL JOINT-NAMES ON
DISPLAY LABEL CHORD-AND-BRACE ON
VIEW FRAME
VIEW ZOOM IN
```

3.3 Definition of Fatigue Points

A fatigue point is a point on the structure that is to be examined for possible inspection or performed inspection. This is typically a hotspot on a cross section of a beam, e.g. at a chord/brace intersection. As outlined in Section 3.1, these must have been identified before Profast is started.

Fatigue points are created by use of the command CREATE FATIGUE-POINT. Most of the attributes of the fatigue points are assigned by use of various assign commands. These commands are available in the graphical user interface under the “Model -> Fatigue Point” pull down menu.

Fatigue points can be of different types:

- PLATE and TUBE points are user defined points in a plate or tube geometry. The structure on which they are located is not known by Profast.

- JOINT points are located at a chord/brace intersection of a jacket structure imported in the Framework database.
- MEMBER points are located at a fatigue check position along a member in a jacket structure imported in the Framework database.

The JOINT and MEMBER options are available only when a database created by Framework is used. When such a point is created, the existing SCF values are transferred, the corresponding transfer functions are created and assigned, the existing SN curve assignment is used and a Sum-Rayleigh stress range is assigned.

It is usually convenient to use at most 5 characters for the name of a fatigue point. When reading transfer functions and creating planned inspections, Profast will create names based on the fatigue point name if this is not too long. For example, the transfer function applied to the axial stress concentration factor is named by appending TRA to the fatigue point name, provided that this transfer function name does not exceed 8 characters. If it would do so (i.e. if the fatigue point name has more than 5 characters), an arbitrary name is selected.

The following commands will create the two fatigue points used in the tutorial example. Also shown is the response from Profast from the first command:

```
CREATE FATIGUE-POINT J5120 ' ' JOINT 5120 35415 BRACE 10
      Brace    35415 at CHORD-SIDE      joint     3220
    * Joint type is reset from KTK to K   since only  2 near braces
      Brace    35415 at BRACE-SIDE      joint     3220
    * Joint type is reset from KTK to K   since only  2 near braces
      Brace    35415 at BRACE-SIDE      joint     5120
    * Joint type is reset from KTK to K   since only  2 near braces
      Brace    35415 at CHORD-SIDE      joint     5120
    * Joint type is reset from KTK to K   since only  2 near braces
      Created Variable J5120-ODiam as fixed with value 700.0
      Created Variable J5120-Thick as fixed with value 20.0
      Created Variable J5120-aTRF as fixed with value 1.0
      Created Variable J5120-bTRF as fixed with value 0.0
      Created Variable J5120-cTRF as fixed with value 0.0
      Created Variable J5120-RSP as fixed with value 1.0
      Created Variable J5120-SFacto as fixed with value 1.0
      Created Variable J5120-IFacto as fixed with value 1.0
      Created Variable J5120-ASCF as fixed with value 2.5
      Created Variable J5120-ISCF as fixed with value 3.53553
      Created Variable J5120-OSCF as fixed with value 3.53553
      Assigned SCF values to Fatigue point J5120:
          SCFax :     2.50000       1/Area:      2.34051E-05
          SCFipb:     3.53553       z/Iy  :     -1.00129E-07
          SCFopb:     3.53553       y/Iz  :      1.00129E-07
      Assigned transfer functions J5120TRA J5120TRI J5120TRO to J5120
      Created Variable J5120-MinerS as fixed with value 1.0
      Created Variable J5120-lK0 as Normal( Mean-Std 15.3801, 0.4 )
      Created Variable J5120-m0 as fixed with value 4.1
      Created Variable J5120-lN0 as fixed with value 8.301
      Created Variable J5120-ThFac as fixed with value 1.0
      SN curve DNVX assigned to J5120
      Created Fatigue point J5120 at hotspot 10 in Brace side of Joint/Brace
      connection 5120 / 35415
```

```
CREATE FATIGUE-POINT J3220 ' ' JOINT 3220 35415 BRACE 10
```

Note that the values J5120-ODiam and J5120-Thick indicate that brace 35415 at joint 5120 has a pipe cross section with outer diameter 700mm and wall thickness 20mm.

Note also that a correction factor is applied to the bending SCF values at hotspots 4, 10, 16 and 22 for PIPE elements when the SCF distribution is either CROWN-SADDLE or PARAMETRIC (as is the case here). In Framework, this correction is applied during a fatigue check analysis, and does not show up in the printed output. In Profast this correction is applied when the SCF values are transferred into the Profast database, and thus will show up in the printed output. The SCF values will therefore in this case appear to be different in Framework and Profast. This correction has been applied in order to achieve the same deterministic fatigue life in Profast as is calculated using a stochastic fatigue analysis in Framework. The correction factor can be manipulated in Profast by use of the command DEFINE FATIGUE-CONSTANTS, but the change will only take effect for fatigue points created after it has been made.

The “Create Fatigue Point” dialog box is set up here to create one of the two fatigue points used in the tutorial example:

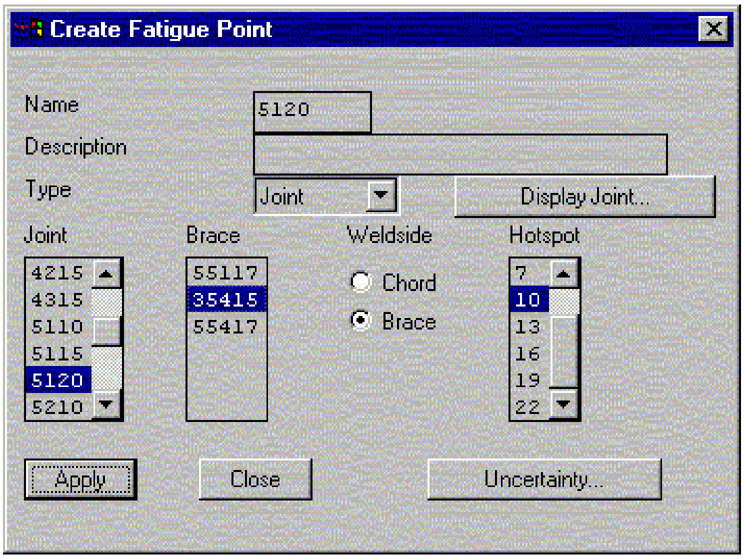


Figure 3.4 Dialog box for creating a fatigue point

Fatigue points and their associated data can be printed. Immediately after creation, the fatigue point J5120 gives the following print:

```
PRINT FATIGUE-POINT J5120
FatigPnt Contents         Value
------------------------------------------------------------------------------
J5120    Type             Hotspot in brace at chord/brace connection
         Position         Joint 5120, Brace 35415, Hotspot 10 in Brace
         Outer Diam       700.0   Uncertainty: None
         Thickness        20.0   Uncertainty: None
         Target Rel.      Not assigned
         Insp. Qual.      Not assigned
```

```
Inspection        None performed
SCF               SCFax :     2.50000   Uncertainty: None
                  SCFipb:     3.53553   Uncertainty: None
                  SCFopb:     3.53553   Uncertainty: None
                  1/Area:    2.3405139E-05
                  z/Iy  :   -1.0012924E-07
                  y/Iz  :    1.0012924E-07
                  Common factor: 1.0   Uncertainty: None
Transfer Func     Wave height linearisation
                   axi: J5120TRA  ipb: J5120TRI  opb: J5120TRO
                  Factor a: 1.0   Uncertainty: None
                  Factor b: 0.0   Uncertainty: None
                  Factor c: 0.0   Uncertainty: None
                  Stress resp. factor: 1.0   Uncertainty: None
Stress range      Sum Rayleigh distribution is calculated
SN Curve          DNVX
                  lK0   : Normal( Mean-StD 15.3801 , 0.4)
                  m0    : 4.1   Uncertainty: None
                  lN0   : 8.301   Uncertainty: None
Miner Sum         1.0   Uncertainty: None
```

3.4 Modelling Uncertainties

The basic principle in Profast is, that the user should be required only to specify the uncertainties, and not need to worry about the application of probabilistic methods.

The Proban commands CREATE VARIABLE and CHANGE VARIABLE can be used to model constant and random variables. However, this method may require some knowledge about probabilities and statistics. Therefore, a simpler way has been introduced, with default distributions and default uncertainty values defined for a number of input parameters, e.g. for the stress concentration factors and the crack sizes.

3.4.1 Specifying Uncertainty on Input Parameters

Parameters that can be uncertain are almost always attached to a named object, e.g. the crack growth parameters lnC and m are attached to a fatigue point. These parameters are named from the object they are attached to, e.g. as NAME-lnC and NAME-m.

Each uncertain parameter has a deterministic value (defined as the input value in the command where it is set) and an attached variable, which is used to keep the uncertainty. For example, these are the variables referred to by Profast in the messages following the creating of a fatigue point (see above). Such a variable has the same name as the parameter, but truncated to 12 characters.

All these derived variables are listed in Appendix B.

Uncertainty is assigned through the command ASSIGN UNCERTAINTY VALUE and can be printed by use of PRINT UNCERTAINTY VALUE. The commands PRINT VARIABLE, PRINT DISTRIBUTION and DISPLAY DISTRIBUTION may also be used to examine the variables associated with the stochastic parameters (See Figure 3.5).

```
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-OSCF ) MEDIUM
      Changed Variable J5120-OSCF to Normal( Mean-CoV: 3.53553, 5.0E-02)
```

In the graphical user interface, all uncertainty modelling is available through the “Model” pull down menu.

Uncertainty can be assigned using the default low, medium or high values, specified as a standard deviation or as a coefficient of variation (i.e. (standard deviation)/(absolute value of mean)). However, for some distributions the uncertainty is a function of the mean (e.g. the Exponential distribution). In such a case, uncertainty can be switched on or off, but the magnitude of the uncertainty cannot be specified because it is already known:

```
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-a0 ) KNOWN
      Changed Variable J5120-a0 to Exponential( Mean-Low: 0.11, 0.0)
```

Alternatively, no uncertainty can be specified (as NONE) or, in special cases, the uncertainty can be specified through another variable. In the latter case, the deterministic value of the parameter is set to the mean value of the variable, if possible.

The following graphs have been generated using the commands:

```
SET TITLE 'Distribution of SCF values with Medium uncertainty' ' ' ' ' ' '
SET DRAWING FONT-SIZE RELATIVE 1.5
DISPLAY DISTRIBUTION ONLY J3220*SCF DENSITY
DISPLAY DISTRIBUTION ONLY J3220*SCF DISTRIBUTION
```

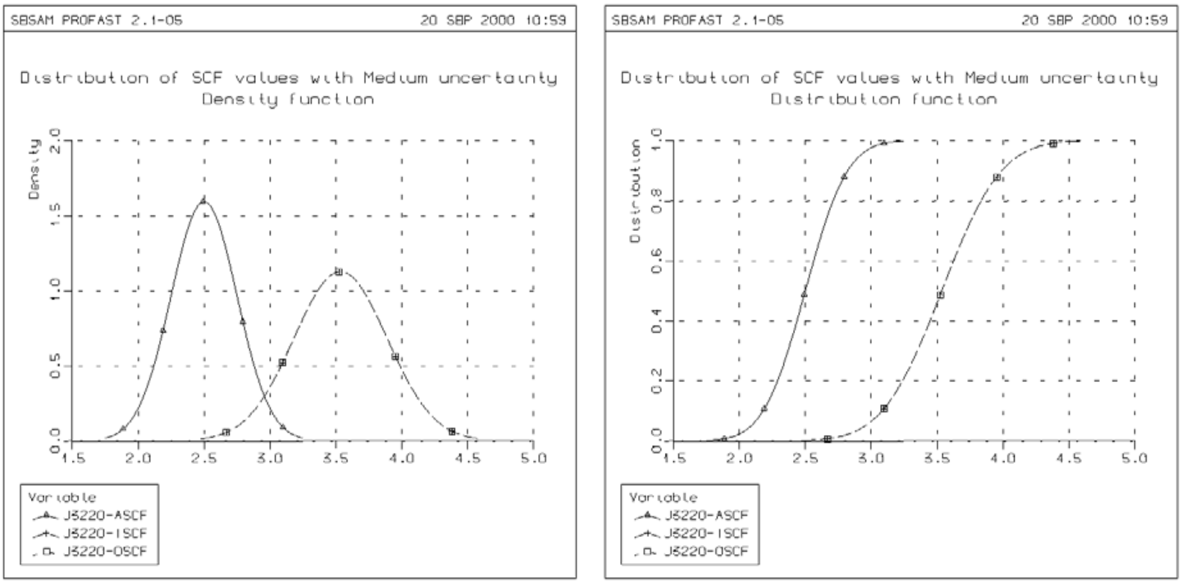


Figure 3.5 Distribution of SCFs with medium uncertainty applied

When desired, the random variables associated with the stochastic parameters can be correlated using the command ASSIGN CORRELATION. For example, modelling the load at the two ends of the same member to have a positive correlation:

```
ASSIGN CORRELATION ( J3220-lnA J5210-lnA ) BASIC 0.8
```

or

```
CREATE VARIABLE CorrLoad 'Load correlation at member 35415' FIXED 0.8
ASSIGN CORRELATION ( J3220-lnA J5210-lnA ) BASIC CorrLoad
```

Both commands will set the same correlation value, but the latter approach have the advantage of allowing a sensitivity study on the value of the correlation.

The definition of the default uncertainty can be examined by use of PRINT UNCERTAINTY DEFINITION and changed by use of DEFINE UNCERTAINTY. The definition is accessible through the type of the object it is attached to instead of the name of a stochastic parameter, e.g. it is accessible as FatigPnt-lnC and FatigPnt-m instead of J3220-lnC and J3220-m.

The definition of uncertainty includes

- The default distribution
- The bounds on the distribution, when required
- The default low, medium and high values, when the uncertainty is not known from the mean value. Each of these may be specified as a coefficient of variation and/or a standard deviation. If both are specified, the value of the two that generates the largest standard deviation is used. Note that it is necessary to specify a standard deviation if the mean value can be zero.

If a definition is changed, all stochastic parameters based on this definition will have their distribution changed accordingly.

For example, to change the default uncertainty for the initial crack depth to a Lognormal distribution, and such that the low, medium and high uncertainty is specified as a coefficient of variation and that medium uncertainty is the default when a new initial crack depth is created (note that the Lognormal distribution requires a lower bound, in this case set to 0.0):

```
DEFINE UNCERTAINTY FatigPnt-a0 LogNormal MEDIUM 0.0
                                         NOT-USED NOT-USED NOT-USED 0.1 0.01 0.05
      The uncertainty definition of FatigPnt-a0 has been changed
      The default uncertainty for FatigPnt-a0 has been changed to: Medium
      Changed Variable J5120-a0 to Lognormal( Mean-CoV-Low: 0.1, 5.0E-02, 0.0)
      Changed Variable J3220-a0 to Lognormal( Mean-CoV-Low: 0.1, 5.0E-02, 0.0
```

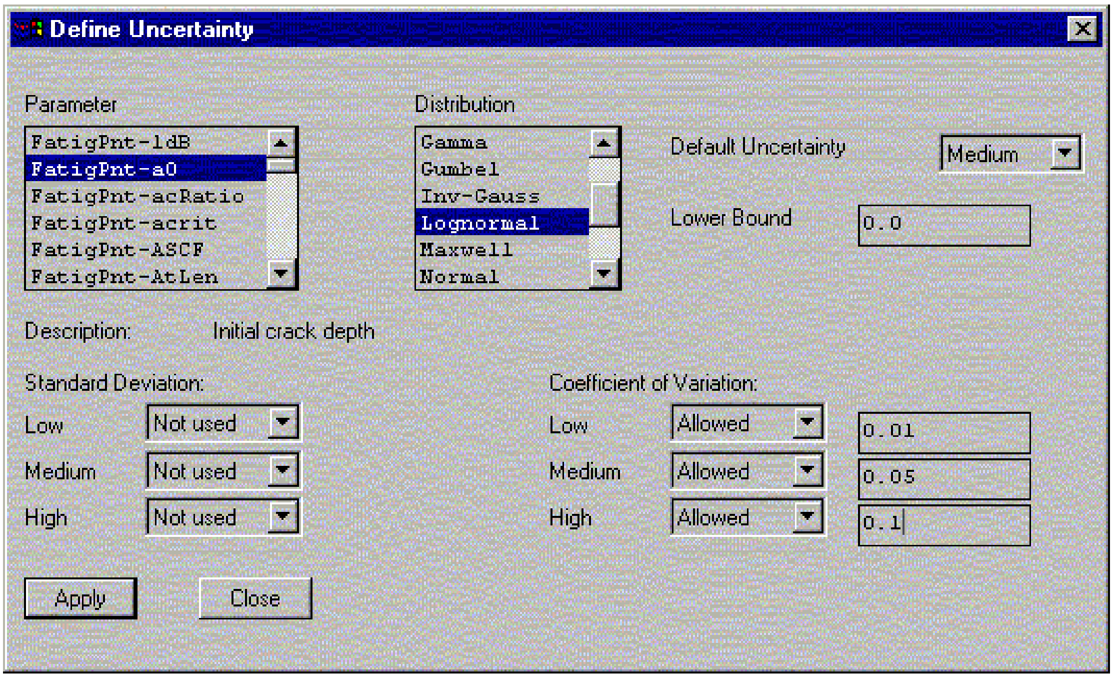


Figure 3.6 Dialog box for definition of uncertainties

There is generally not a large need for modelling random variables directly in Profast, except for POD distributions. However, when required, the commands CREATE/CHANGE VARIABLE can be used to model random variables with built-in uncertainty and constant values.

The following types of variables are available:

- DISTRIBUTION

  These variables are specified as following a random distribution. there is usually a choice between different sets of input parameters. See the Proban Distributions manual for details.

- FITTED-DISTRIBUTION

  These variables are also specified as following a random distribution. However, some or all of the distribution parameters are fitted to data values. These data values can be input by the user or generated by an analysis.

- FIXED

  These variables have a constant value.

- FUNCTION

  These variables are a function of other variables and/or numerical values. The library of available functions can be examined by use of the PRINT FUNCTION command.

- GENERATED

The distribution of these variables are generated from another variable. All variables generated from the same variable become independent, identically distributed variables (except if conditioning is applied, see ASSIGN CONDITIONING).

The POD variables used at inspections are modelled in this manner. The POD distribution is defined by a single random variable, and all instances of this POD distribution are generated from this variable, thus becoming independent and identically distributed.

For more details, see the command descriptions in Chapter 5.

Note that Profast creates and names a number of variables. These variables are write protected, and cannot be changed by the user.

3.5 Environment, Forces and Load Modelling

3.5.1 Modelling Environmental Data

In order to obtain the environmental description required for calculating the Sum-Rayleigh stress range distribution, the user must enter a scatter diagram and assign wave direction probabilities to all wave directions. The scatter diagram must have one or more wave spectrum shapes assigned and optionally one or more wave spreading functions.

An environmental model that has already been defined in Framework and exist in the database can be reused in Profast, except that the Nordenstrom wave statistics cannot be used by Profast.

The following commands illustrate the process (the commands are identical in Framework).

This example creates a scatter diagram with 5 sea states (the probabilities of the last two entries are added):

```
CREATE WAVE-STATISTICS SCATTER 'ARBITRARY DATA'
       SCATTER-DIAGRAM PROBABILITY
       (
       % Hs      Tz    Prob
         1750.0  4.75  0.249
         1750.0  7.75  0.086
         1250.0  6.25  0.236
         3250.0  6.25  0.206
         4750.0  7.75  0.117
         4750.0  7.75  0.106
       )
      Total probability of the scatter diagram is: 1.00
```

A wave spreading function may be created using this command:

```
CREATE WAVE-SPREADING-FUNCTION DIS2 'DISCRETE COS**2' USER-DEFINED
      (
%%  Dir  Weigth
     -45  0.25
       0  0.50
      45  0.25
      )
```

And then applied to all of the scatter diagram:

```
ASSIGN WAVE-SPREADING-FUNCTION SCATTER DIS2 ALL
```

A Pierson-Moskowitz spectrum is applied to all sea states:

```
ASSIGN WAVE-SPECTRUM-SHAPE SCATTER PIERSON-MOSKOWITZ ALL
```

The scatter diagram is applied to each of the main wave directions.

```
ASSIGN WAVE-STATISTICS
  LOOP
%  Dir Scatter diagram
   -45 SCATTER
     0 SCATTER
    45 SCATTER
    90 SCATTER
   135 SCATTER
  END
```

The probability of occurrence for each of the main wave directions is defined:

```
ASSIGN WAVE-DIRECTION-PROBABILITY
  LOOP
%  Dir Prob
   -45 0.0
     0 0.9
    45 0.0
    90 0.1
   135 0.0
  END
```

This modelling may be verified using PRINT and DISPLAY commands.

3.5.2 Applying Forces to a Fatigue Point

The forces can be applied either through SCFs (Stress Concentration factors) or influence coefficients.

In the graphical user interface, the SCFs and influence coefficients are accessible through the “Model” pull down menu. The transfer functions are accessible through the “Load” pull down menu.

If a database created by Framework is used, and the fatigue point is of JOINT or MEMBER type, Profast will automatically read SCFs from the database and assign them to the fatigue point if they are available. Profast will also read the corresponding transfer functions and assign them to the fatigue point. It is possible to override both the SCFs and the transfer functions with user defined values if desired. The default assignment is shown when a fatigue point is created (see Section 3.3).

The ASSIGN SCF command is used to apply user defined SCFs to a fatigue point. Three SCFs (axial, in-plane bending and out-of-plane bending) and the reciprocal of the three corresponding cross section properties must be applied. After this, three transfer functions must be assigned, by use of the CREATE TRANSFER-FUNCTION (if needed) and ASSIGN TRANSFER-FUNCTION commands.

Instead of the three stress concentration factors, up to 99 influence coefficients can be applied. The command ASSIGN INFLUENCE-COEFFICIENTS is used to apply influence coefficients at a fatigue point.

Each influence coefficient is multiplied with a scaling factor, which is multiplied with the influence coefficient during the calculation. One transfer function must be assigned to each coefficient by use of the ASSIGN TRANSFER-FUNCTION command. Each influence coefficient represents one degree of freedom, and it is up to the user to keep track of the correct pairing of coefficients and transfer functions.

See also the example at the end of this section.

Uncertainty can be applied to each SCF or to each influence coefficient. See Chapter 5 for details.

Transfer functions can be read from a SIN file, if available, or be specified directly as a set of points. Please note that each named transfer function in Profast is defined for one degree of freedom and for all wave directions. Transfer functions can be displayed. The following graphs were created by use of these commands:

```
SET DRAWING FONT-SIZE RELATIVE 1.5
DISPLAY TRANSFER-FUNCTION * 0
DEFINE PRESENTATION TRANSFER-FUNCTION ORDINATE PHASE-AMPLITUDE
DISPLAY TRANSFER-FUNCTION J3220TRO 0
```

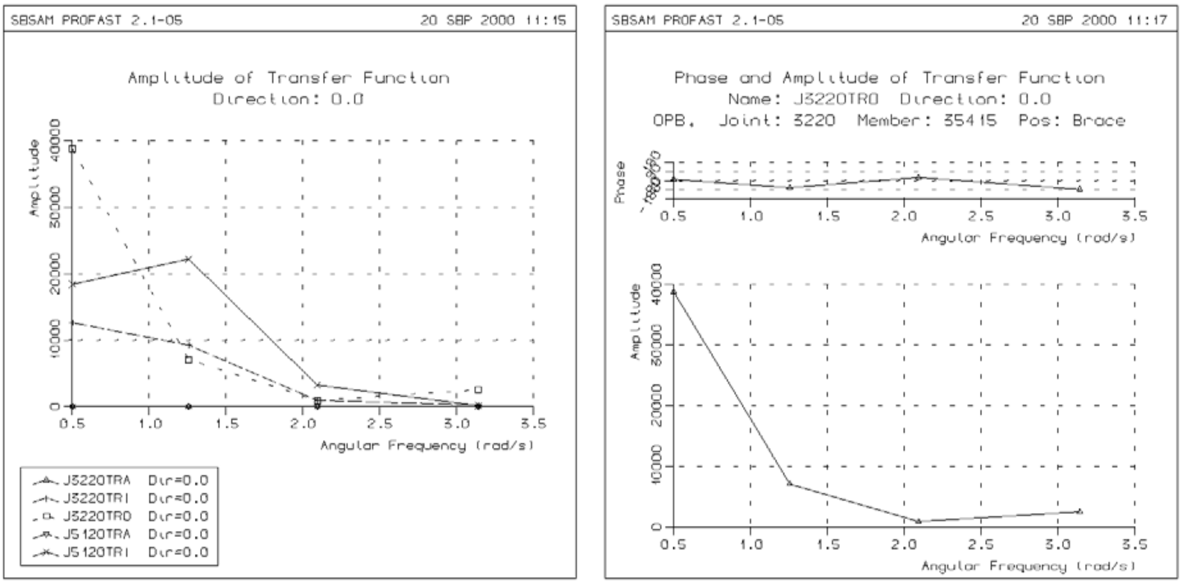


Figure 3.7 Display of transfer functions

The following example regenerates the default transfer of stress concentration factors and transfer functions for fatigue point J3220 (the response from Profast is not shown):

```
CREATE TRANSFER-FUNCTION J3220TRA ' ' USER-SPECIFIED 30.0
    ( ONLY -45.00    0.503   7.923E+01  6.749E+01
           -45.00    1.257  -1.821E+01  1.210E+01
           -45.00    2.094  -5.479E+01  8.118E+01
           -45.00    3.142   2.719E+01  9.859E+01
             0.00    0.503   9.071E+00  5.807E+00
             0.00    1.257   1.754E+00 -1.664E+00
```

```
            0.00    2.094  -6.567E-01  2.507E+00
            0.00    3.142  -6.314E-01 -3.063E+00
           45.00    0.503  -6.350E+01 -6.241E+01
           45.00    1.257   2.682E+01 -2.768E+01
           45.00    2.094   2.875E+01 -9.075E+01
           45.00    3.142  -2.678E+01 -1.028E+02
           90.00    0.503  -7.725E+01 -1.104E+02
           90.00    1.257   2.921E+01  1.701E+02
           90.00    2.094   2.950E+01  2.937E+01
           90.00    3.142  -1.353E+01 -1.124E+02
          135.00    0.503  -3.790E+01 -9.538E+01
          135.00    1.257  -1.923E+01 -6.543E+00
          135.00    2.094  -6.111E+01 -7.586E+01
          135.00    3.142   2.299E+01 -9.951E+01 )
CREATE TRANSFER-FUNCTION J3220TRI ' ' USER-SPECIFIED 30.0
    ( ONLY -45.00    0.503  -1.568E+04  5.461E+03
          -45.00    1.257   3.623E+03  4.924E+02
          -45.00    2.094  -3.351E+03  3.654E+03
          -45.00    3.142   1.504E+03  5.174E+03
            0.00    0.503  -6.595E+03  1.075E+04
            0.00    1.257   9.073E+03  1.723E+03
            0.00    2.094   1.010E+02  9.231E+02
            0.00    3.142  -5.749E+01 -1.944E+02
           45.00    0.503   1.057E+03  1.118E+04
           45.00    1.257  -1.156E+03  3.209E+03
           45.00    2.094   5.583E+02 -5.008E+03
           45.00    3.142  -1.293E+03 -5.461E+03
           90.00    0.503  -5.049E+03  1.317E+04
           90.00    1.257   4.308E+03  7.724E+03
           90.00    2.094   1.977E+03  7.616E+02
           90.00    3.142  -1.292E+03 -5.938E+03
          135.00    0.503  -9.336E+03  8.808E+03
          135.00    1.257   4.066E+03 -1.204E+03
          135.00    2.094  -3.664E+03 -3.350E+03
          135.00    3.142   1.287E+03 -5.226E+03 )
CREATE TRANSFER-FUNCTION J3220TRO ' ' USER-SPECIFIED 30.0
    ( ONLY -45.00    0.503   1.961E+04  5.445E+03
          -45.00    1.257  -6.200E+03 -4.554E+03
          -45.00    2.094  -1.004E+03 -2.841E+03
          -45.00    3.142   4.786E+02 -2.424E+03
            0.00    0.503   3.805E+04  7.502E+03
            0.00    1.257   2.453E+03 -6.660E+03
            0.00    2.094   7.825E+02  4.679E+02
            0.00    3.142   1.429E+02 -2.505E+03
           45.00    0.503   2.425E+04  1.402E+04
           45.00    1.257   4.630E+03  3.693E+03
           45.00    2.094   3.238E+03  6.634E+02
           45.00    3.142  -5.920E+02 -2.128E+03
           90.00    0.503   7.563E+03  4.060E+03
           90.00    1.257  -1.432E+03 -5.399E+03
           90.00    2.094  -3.356E+03 -4.487E+02
           90.00    3.142   8.996E+02  8.401E+02
```

```
          135.00    0.503  -1.063E+03 -2.006E+04
          135.00    1.257  -5.484E+03  5.974E+03
          135.00    2.094  -7.991E+02  2.817E+03
          135.00    3.142   5.801E+02  2.390E+03 )
ASSIGN SCF J3220 2.5 2.3405139E-05 3.53553 -1.0012924E-07 3.53553 -1.0012924E-07
ASSIGN TRANSFER-FUNCTION J3220 WAVE-HEIGHT ( ONLY J3220TRA J3220TRI J3220TRO )
```

If the same effect should be modelled using influence coefficients, the ASSIGN SCF command would be substituted with one of the following commands:

```
ASSIGN INFLUENCE-COEFFICIENTS J3220
       ( ONLY 2.5 2.3405139E-05 3.53553 -1.0012924E-07 3.53553 1.0012924E-07
ASSIGN INFLUENCE-COEFFICIENTS J3220
       ( ONLY 5.8512792e-05 1.0 -3.5401003e-07 1.0 3.5401003e-07 1.0 )
```

In the first case, the factors are identical to the reciprocal cross section properties. In the second case, the reciprocal cross section properties have been multiplied into the stress concentration factors, and the corresponding factors have been set to 1.0.

3.5.3 Modelling the Long Term Stress Range Distribution

There are four ways to assign the stress range:

- As a constant value, with optional uncertainty.
- As a Weibull distribution with specification of ln(A), the logarithm of the scale parameter and 1/B, the reciprocal of the shape parameter. Both these parameters can be uncertain.
- As a sum of Rayleigh distributions, based on the environmental and force description supplied above (see Section 3.5.1 and Section 3.5.2). The calculation of the Sum-Rayleigh distribution is described in the Profast Theory Manual.
- As a Weibull fit to the sum of Rayleigh distributions. See below for details.

The uncertain parameters applied to calculation of the Sum-Rayleigh distribution are described in the following section. When a JOINT or MEMBER type fatigue point is created, the Sum-Rayleigh type stress range is automatically assigned.

If a constant stress range is used, or a direct specification of the Weibull distribution, the number of load cycles per second must be specified. This value is automatically calculated when the Sum-Rayleigh or Weibull-fit stress range distribution is used. Uncertainty can be assigned to the number of load cycles per second.

The fit to the Weibull distribution produces the two Weibull parameters ln(A) and 1/B as uncertain parameters. It can be done in one of three ways:

1 As a deterministic fit, fitting to the 95% and 99% fractiles of the Sum-Rayleigh distribution.

2 As a deterministic fit, fitting to fractiles of the Sum-Rayleigh distribution at user defined probability values.

3 As a probabilistic fit, fitting to fractiles of the Sum-Rayleigh distribution at three user defined probability values.

The first two methods produce values of ln(A) and 1/B with no uncertainty (uncertainty can be applied later if required). The last method may apply uncertainty to one or both of these, as well as introduce a correlation between them.

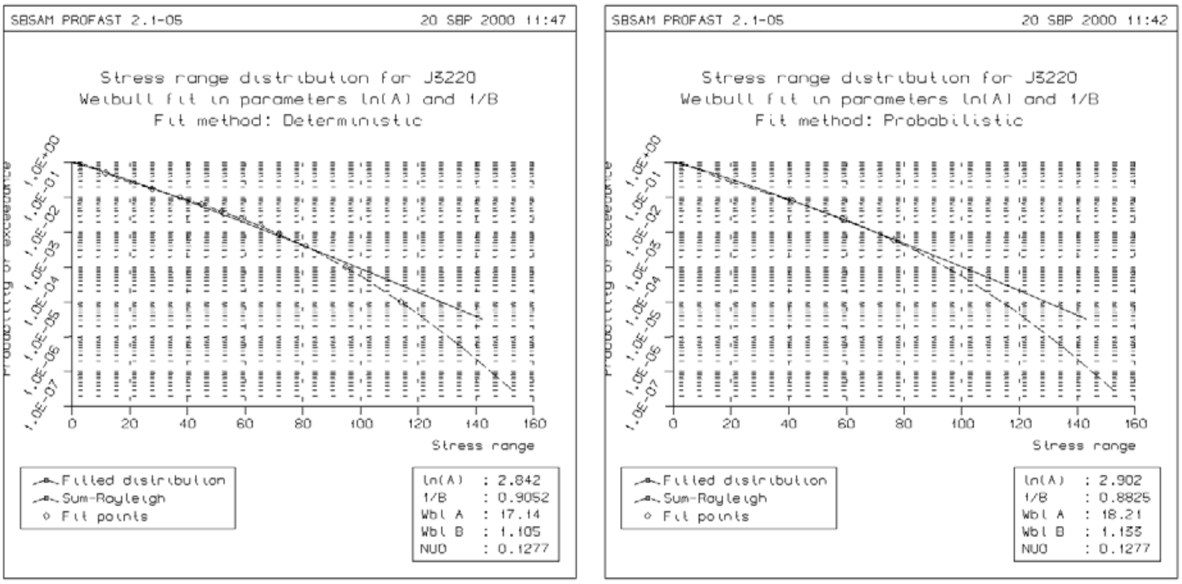


Figure 3.8 Display of weibull fits to the long term stress range distribution

The command DEFINE WEIBULL-FIT is used to set the probability values at which the fit is performed and ASSIGN STRESS-RANGE is used to assign the long term stress range definition to a fatigue point. In the graphical user interface, the long term stress range is accessible through the "Load -> Stress Range" pulldown menu.

```
ASSIGN STRESS-RANGE J3220 WEIBULL-FIT PROBABILISTIC
      Created Variable J3220-lnA as Normal( Mean-StD: 2.9032, 3.239027E-02)
      Created Variable J3220-1dB as fixed with value 0.882666
      Created Variable J3220-nu0 as fixed with value 0.127833
      Assigned Stress range to J3220 as Weibull Fit
```

The stress range assignment can be displayed if it is not constant, using DISPLAY STRESS-RANGE. In the case of a Weibull fit, an impression of the fit can be gained (see Figure 3.8).

Please note that in some cases, the SN life time calculated with the Sum-Rayleigh stress distribution and the fitted Weibull stress distribution may be quite different. In such a case, it may be advantageous to look into these possibilities:

- It may be a good idea to specify fit points quite far into the tail (see DEFINE WEIBULL-FIT DETERMINISTIC).

- The probabilistic Weibull fit may provide a better result than the deterministic fit.
- A parameter used in the fit (see next section) may have been given a distribution with a very long tail (e.g. a Lognormal or Exponential distribution).

3.5.4 Uncertainties Applied to a Sum-Rayleigh Stress Distribution

Each wave scatter diagram may have the following uncertainty assigned. The stochastic parameters are named in parenthesis, assuming a scatter diagram named SCAT:

1 Uncertainty on the parameters of the distribution fitted to the scatter diagram. These uncertainties are only in effect when a distribution has been fitted (see ASSIGN WAVE-SCATTER-DISTRIBUTION).

   Uncertain factor on E(HS), the mean of HS (SCAT-EHS).

   Uncertain factor on SD(HS), the standard deviation of HS (SCAT-SHS).

   Uncertain factor on E(TZ), the mean of TZ (SCAT-ETZ).

   Uncertain factor on SD(TZ), the standard deviation of TZ (SCAT-STZ).

   Uncertain factor on Corr(HS,TZ), the correlation between HS and TZ (SCAT-CHT).

   Uncertain factor on the skewness in the Fang-Hogben distribution (SCAT-FHS). This value is only used when a Fang-Hogben distribution is fitted.

2 Uncertainty on the parameter g in any Jonswap spectrum (SCAT-GWS).

   Uncertainty on the parameter sA in any Jonswap spectrum (SCAT-AWS).

   Uncertainty on the parameter sB in any Jonswap spectrum (SCAT-BWS).

3 Uncertainty on the parameter L in any General gamma spectrum (SCAT-LWS).

   Uncertainty on the parameter N in any General gamma spectrum (SC4

4 Uncertainty on the power of a cosine power wave spreading function (SCAT-PWS). No uncertainty can be assigned to a user defined (discrete) wave spreading function.

The wave spectrum parameters are described in the Profast Theory Manual.

Each fatigue point (or inspection with a repair assigned) may have the following uncertainty assigned. The stochastic parameters are named in parenthesis, assuming a fatigue point (or inspection) named FP.

1 Uncertainty on factor (bias) on transfer function as a parabolic function of HS: a +b*HS +c* HS2 (FP-aTRF, FP-bTRF, FP-cTRF).

2 Uncertain factor on stress response (factor on square modulus of transfer function) (FP-RSP).

3 Uncertainty on each SCF (FP-ASCF, FP-ISCF,FP-OSCF) or on each influence coefficient (FP-Ixx, xx = 01,...,99). The value of these parameters may be changed in ASSIGN SCF and ASSIGN INFLUENCE-COEFFICIENT.

Except where noted otherwise, all the values mentioned here can be changed by use of the command ASSIGN MODEL-FACTOR.

The uncertainty of each parameter may be changed by use of ASSIGN UNCERTAINTY VALUE.

3.6 SN Analysis

In the graphical user interface, all commands necessary for setting up, executing and examining results from an SN analysis are available under the “SN-Fatigue” pulldown menu, with the exception of stress range and uncertainty modelling.

3.6.1 Setting up the SN Analysis

To be able to perform an SN analysis, the following steps must first be completed:

1 An SN curve must first be assigned to the fatigue point using ASSIGN SN-CURVE. If necessary, the SN curve can be created first using CREATE SN-CURVE. The parameters of the SN curve can be uncertain. See CREATE SN-CURVE in Chapter 5 for details.

2 A thickness correction can be applied to the SN curve. See the command ASSIGN THICKNESS-CORRECTION in Chapter 5 for details.

3 The critical damage value must be assigned using ASSIGN MINER-SUM-CRITICAL. The critical damage can be uncertain. The default value is 1.0 with no uncertainty assigned.

4 A stress range must be assigned, see Section 3.5.3.

If a JOINT or MEMBER type fatigue point is used, these settings will when possible have default values read from the database. It is usually possible to go directly from the creation of the fatigue point to the SN analysis in this case.

3.6.2 SN Curves

There are a few special considerations regarding SN curves, which the user should be aware of:

A number of SN curves have been preprogrammed. These are listed in Table 2.1 on page 2-7. These curves cannot be changed. Note that these predefined curves are in N/m2. However, when imported from Framework, these curves can be used with a model in different units provided that the E modulus is 2.1*1011 N/mm2, as the stress will automatically be scaled to the proper size by using the size of the E modulus in the units actually used. If no Framework model has been imported, or if the E modulus has a different value, it is the responsibility of the user to specify the SN curve in consistent units.

Most SN curves have a different deterministic and stochastic representation. This is because the SN curves used for deterministic analysis, e.g. in Framework, usually incorporate a safety factor by shifting the parameter log(K) with two standard deviations. Thus, if uncertainty is to be incorporated on K in a probabilistic analysis, log(K) is represented as having a Normal distribution with the original mean (without safety factor) and with the standard deviation that was originally used to compute the value of log(K) used deterministically. See also Section 2.5.1.

The thickness correction was applied differently in the original Profast. To be exact, the reciprocal of value computed from the formula in Figure 5.1 shall be identical to the thickness correction factor from old Profast uplifted to the power 1/m0, where m0 is the slope of the first section of the SN curve.

In the tutorial example, the following SN curve is defined in Framework:

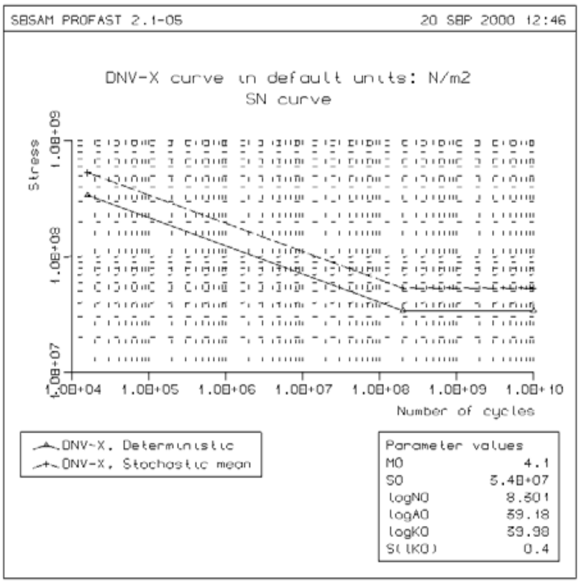
```
CREATE SN-CURVE DNVX USER 'DNV-X curve in N/mm2' 4.1 34.0 8.301 HORISONTAL-TAIL
```

This is the same as the predefined DNV-X curve, but specified in mm instead of m. In Profast, this curve is changed in order to incorporate uncertainty (this uncertainty is already built into the predefined DNV-X curve):

```
CHANGE SN-CURVE DNVX UNCERTAINTY 0.4
```

The UNCERTAINTY input option is the simplest way to modify the standard deviation of log10(K). There is also a STOCHASTIC option, where log10(K) and the standard deviation of this as input instead of the stress level S (the STOCHASTIC and UNCERTAINTY input option is not available in Framework).

SN curves may be displayed using DISPLAY SN-CURVE. When a standard deviation on log10(K) is defined, both the deterministic and stochastic curves are drawn:



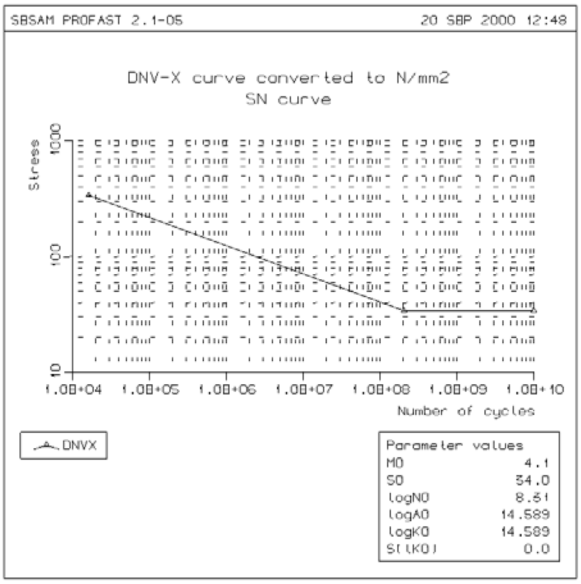


Figure 3.9 Display of SN curve

3.6.3 Executing the SN Analysis and Examination of Results

The command RUN SN-ANALYSIS is used. There are three options:

- Calculate the time to failure, deterministic or as a random distribution.
- Calculate the failure probability as a function of time
- Update the variables and events that are used in the analysis (see below).

In the graphics user interface, the pulldown menus “SN-Fatigue -> Life time” and “SN-Fatigue -> Failure probability” are used.

The SN analysis model is contained in two random variables and one event, with names derived from the name of the fatigue point, but abbreviated to 12 characters. In the case of the fatigue point J3220, these will be:

J3220-SNLife VARIABLE	Time to SN failure in years
J3220-SNFail VARIABLE	Limit state value (i.e. negative if failure, positive if safe).
J3220-SNFail EVENT	Failure event (i.e. J3220-SNFail < 0)

These variables and events will be updated when needed by an analysis, or when an update is specifically requested by RUN SN-ANALYSIS UPDATE-MODEL (see also Appendix B).

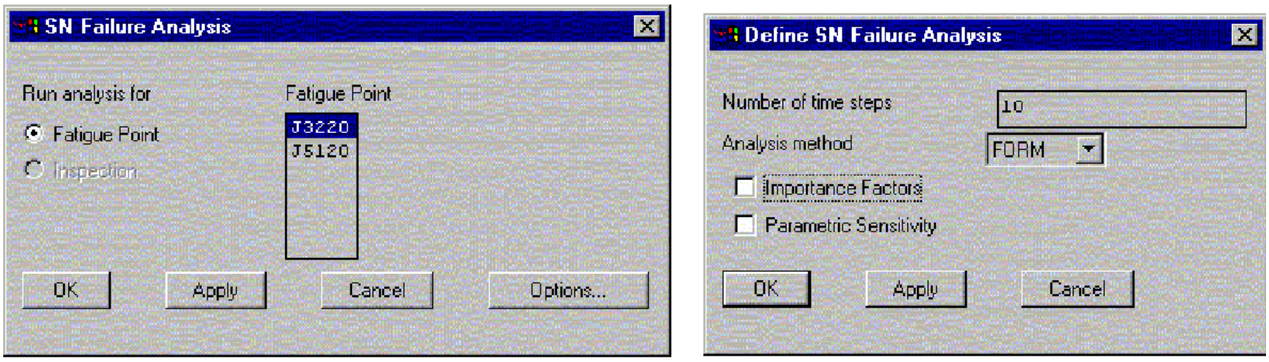


Figure 3.10 Dialog box for SN failure probability analysis and corresponding options

The analysis setup is defined through DEFINE SN-ANALYSIS FAILURE-PROBABILITY or through the DEFINE commands used to manipulate distribution analysis, e.g. DEFINE DISTRIBUTION-SIMULATION. Note that sensitivity analysis is turned off by default for probability analysis. This is to save computation time. It may however be informative to turn on importance factor calculation at least once to see the contribution each uncertainty makes to the failure probability. The number of time steps in the failure probability analysis defines the number of SN analyses used to map the failure probability over time. If set to 1, the analysis is performed at the end of the service life only.

The analysis method to be used for failure probability analysis is defined through DEFINE SN-ANALYSIS FAILURE-PROBABILITY METHOD or, if the DEFAULT option is selected, through the command SELECT ANALYSIS-METHOD PROBABILITY. The analysis method used for probabilistic life time analysis is defined using SELECT ANALYSIS-METHOD DISTRIBUTION.

The analysis results are stored with the names NAME-SNLife and NAME-SNFail respectively. The analysis results may be examined by use of PRINT/DISPLAY SN-ANALYSIS or, for a more detailed examination of one result, the commands SELECT RESULT followed by PRINT/DISPLAY RESULT may be used.

The following commands were used to generate these plots (note that the dominating uncertainty on log(K) was removed from the last plot to be able to discern the effect of the remaining values):

```
DEFINE SN-ANALYSIS FAILURE-PROBABILITY IMPORTANCE ON
RUN SN-ANALYSIS FAILURE-PROBABILITY J3220
SET DRAWING FONT-SIZE RELATIVE 1.5
DISPLAY RESULT IMPORTANCE 2020.5
DISPLAY RESULT PARAMETER-STUDY IMPORTANCE
```

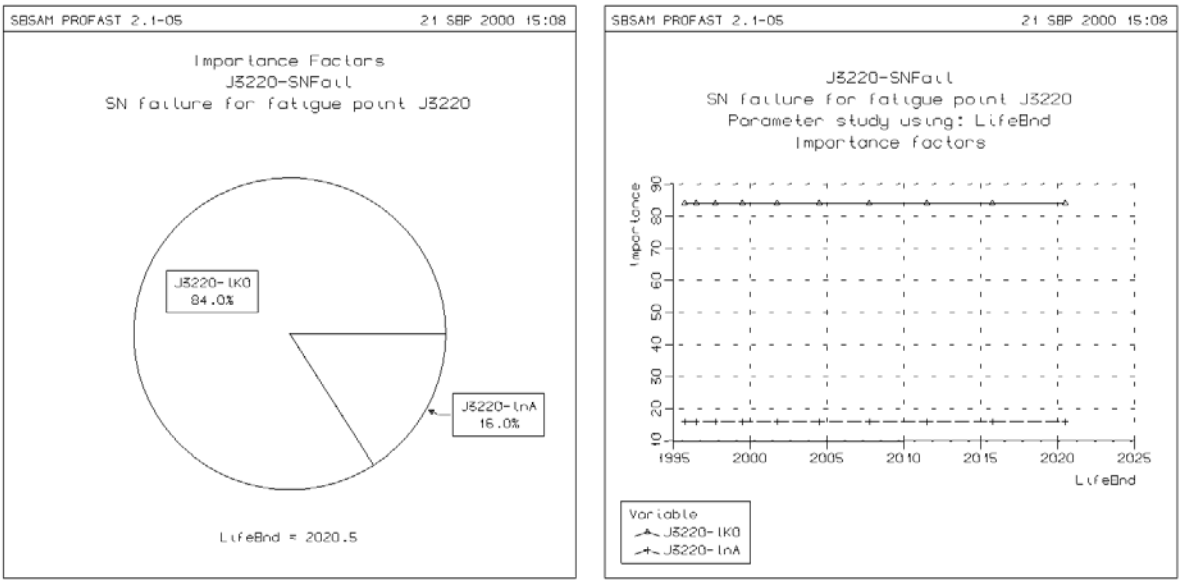


Figure 3.11 Importance factor results from an SN analysis

3.7 Crack Growth Analysis

In the graphical user interface, all commands necessary for setting up, executing and examining results from a crack growth analysis are available under the “Crack-Growth” pulldown menu, with the exception of stress range and uncertainty modelling.

3.7.1 Setting up the Crack Growth Model and Geometry

The crack growth model and geometry is assigned in three parts:

1. The dimension of the crack growth model and the corresponding parameters must be assigned first, using ASSIGN CRACK-GROWTH-MODEL. The dimension of the crack growth model affects the possible choice of geometry and crack types.

2. The geometry, crack type and stress intensity specification must then be assigned, using ASSIGN GEOMETRY-FUNCTION. The available choices are documented fully in Chapter 5 with the ASSIGN CRACK-GROWTH-MODEL command and in the Profast Theory Manual, and will not be repeated here except to note that two “free format” geometry functions are available: a polynomial form and a general data fit.

3 In addition, a weld effect may be assigned, using ASSIGN WELD-EFFECT, except for through thickness and edge cracks in a plate. The weld effect never falls below 1.0 and is multiplied on the geometry function. By default, no weld effect is assigned. The options include the British Standard PD6493 and fits to data points. An assigned weld has no effect on the SN analysis.

It is also necessary to have a stress range assigned, either as Weibull distribution or a constant value. A Sum-Rayleigh stress distribution imported from Framework should be exchanged with a Weibull fit before crack growth analysis is performed.

Finally, an SN analysis must be possible if a the crack growth model is to be calibrated to the SN analysis result.

Uncertainty can be applied to a number of the parameters. For more details, see the relevant commands in Chapter 5.

The following table suggest some values for m and lnC, which may be used when no other data are available. Note that these values of ln(C) conform to the units N and mm. Please be careful to specify the value in the correct units. If, for instance, meters were used instead of mm, the following change in ln(C) would be required (note that the material parameter m enters the correction):

ln(C) in (N,m) = ln(C) in (N,mm) - (m * 1.5 + 1) * ln(1000)

The value 1000 is the conversion factor from m to mm. If a different measurement unit is used, a corresponding factor can be applied instead.

If no uncertainty is applied to m, the standard deviation of ln(C) is the same regardless of the units used. However, if uncertainty is applied to m, and possibly also a correlation between m and lnC is introduced, the conversion is more complicated, and it is often better to model the dependency directly. As the values are usually specified in the codes and guidelines in mm, a predefined model function (lnC-UnitConv) exists for just this purpose. It takes three arguments: (1) ln(C) in mm, (2) the material parameter m and (3) the number of mm per unit of measurement. The following command example illustrates the process:

```
% Note that the computation ensures that ln(C) has the correct deterministic value
ASSIGN CRACK-GROWTH-MODEL P 0 PARIS-1DIM 3.5 $ -31.01 - (3.5*1.5+1)*Log(1000)
      Created Variable P-ITime as fixed with value 0
      Created variable P-m as fixed with value 3.5
      Created variable P-lnC as fixed with value -74.18347
ASSIGN UNCERTAINTY P-m STDV 0.1
      Changed variable P-m to Normal( Mean-Std 3.5, 0.1 )
% First model the ln(C) value as specified in mm
CREATE VARIABLE P-lnCmm 'ln(C) in mm for fatigue point P' DISTRIBUTION
                        Normal Mean-Std -31.01 0.77
% Note that the correlation is specified between m and the ln(C) modelled in mm
ASSIGN CORRELATION ( P-m P-lnCmm ) BASIC -0.9
% Then model the modified ln(C) value
CREATE VARIABLE P-lnCm 'ln(C) in m for fatigue point P' FUNCTION
                        lnC-UnitConv P-lnCmm m 1000
% Use the modified ln(C) value as stochastic representation of P-lnC
ASSIGN UNCERTAINTY P-lnC VARIABLE P-lnCm
      Changed P-lnC to be identical to P-lnCm
```

Note that with this setup, a deterministic analysis will represent ln(C) with the value specified in the ASSIGN CRACK-GROWTH-MODEL command (-74.18437), while a probabilistic analysis will use the random variable P-lnCm.

Table 3.1 Suggested crack growth model parameters

Environment	ln(C)	(N,mm) (mean, std.dev)	Reference
In air and non corrosive	3.1	Normal(-29.84, 0.55)	Fatigue Strength analysis for mobile offshore units. DnV, Classification Note No.2, 1984
In sea water	3.5	Normal(-31.01, 0.77)	
In air	3.0	Normal(-29.31, 0.24)	Statistical Scatter in Fracture Toughness and Fatigue Crack Growth Rare Data, Johnston, G.O., ASTM STP 789, 1983, pp 42-66
In are	2.8	Normal(-27.66, 0.23)	Probabilistic Fracture Approach of Fatigue and Brittle Fracture in Tubular Joints, Snijder, H.H. et. al., Proc. Steel in Marine Structures, Amsterdam, The Netherlands, 1987

One dimensional geometry functions and the weld effect can be displayed using DISPLAY GEOMETRY-FUNCTION and DISPLAY WELD-EFFECT.

These are the initial crack growth model settings used in the tutorial example, with Profast responses shown for J3220 (taken from the second line of the table above):

```
ASSIGN CRACK-GROWTH-MODEL J3220 0 PARIS-1DIM 3.5 -31 NO-THRESHOLD
      Created Variable J3220-ITime as fixed with value 0.0
      Created Variable J3220-m as fixed with value 3.5
      Created Variable J3220-lnC as fixed with value -31.0
      Assigned Crack growth model to J3220 as Paris 1Dim
ASSIGN CRACK-GROWTH-MODEL J5120 0 PARIS-1DIM 3.5 -31 NO-THRESHOLD
ASSIGN GEOMETRY-FUNCTION J3220 TUBE-SURFACE DEPTH 0.1 20.0 0.1 .2
      Created Variable J3220-a0 as Exponential( Mean-Low: 0.1, 0.0)
      Created Variable J3220-acrit as fixed with value 20.0
      Created Variable J3220-acRati as fixed with value 0.1
      Created Variable J3220-MSRati as fixed with value 0.2
      Created Variable J3220-GFacto as fixed with value 1.0
      Assigned Geometry function Tube Surface to J3220
ASSIGN GEOMETRY-FUNCTION J5120 TUBE-SURFACE DEPTH 0.1 20.0 0.1 .2
```

Please note that the initial crack depth by default has an Exponential distribution and is uncertain. The geometry function model factor is accessible, if desired, through the command ASSIGN MODEL-FACTOR GEOMETRY-FUNCTION.

After this initial assignment, the following uncertainties are added in the tutorial:

```
ASSIGN UNCERTAINTY VALUE ( ONLY J3220-lnC ) STDV .77
      Changed Variable J3220-lnC to Normal( Mean-StD: -31.0, 0.77)
ASSIGN UNCERTAINTY VALUE ( ONLY J3220-GFactor ) COV .1
```

```
      Changed Variable J3220-GFacto to Normal( Mean-CoV: 1.0, 0.1)
ASSIGN UNCERTAINTY VALUE ( ONLY J3220-acRatio ) COV .1
      Changed Variable J3220-acRati to Normal( Mean-CoV: 0.1, 0.1)
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-lnC ) STDV .77
      Changed Variable J5120-lnC to Normal( Mean-StD: -31.0, 0.77)
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-GFactor ) COV .1
      Changed Variable J5120-GFacto to Normal( Mean-CoV: 1.0, 0.1)
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-acRatio ) COV .1
      Changed Variable J5120-acRati to Normal( Mean-CoV: 0.1, 0.1)
```

3.7.2 Calibration of the Crack Growth Model to the SN Analysis Result

If desired, the crack growth reliability model can be calibrated to the SN reliability result. This is done by manipulating one, two or three parameters in the crack growth model so that the SN and crack growth reliability results become as close as possible at a number of user defined time points. A least squares fit is used, manipulating the parameters according to sensitivity results from the crack growth reliability analysis.

Crack growth calibration is available in the graphical user interface in the pulldown menu under "Crack-Growth -> Calibrate to SN".

There are two convergence criteria, one based on the vertical distance between the curves and one based on the step length of the parameters. Both must be satisfied for convergence to be achieved. If convergence is achieved, Profast will by default automatically update the parameter values. If not, it is up to you to do this manually, if desired. These options are set by use of DEFINE CALIBRATION-CRACK-GROWTH or through the dialog box shown below:

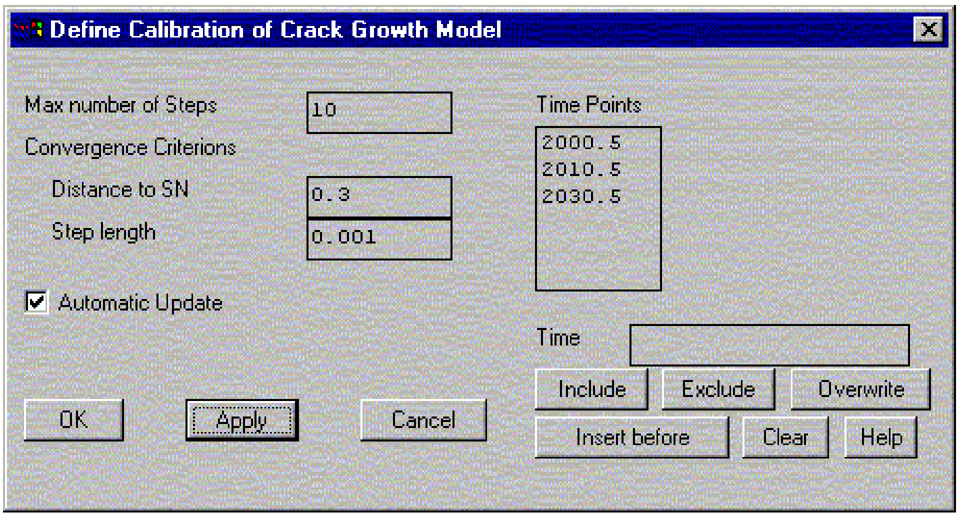


Figure 3.12 Dialog box for setting of calibration options

As can be seen in this example, taken from the tutorial, it is possible to calibrate beyond the service life of the structure.

For the one dimensional crack growth models, the calibration does not always work too well, in that the distance between the curves may remain quite large. The calibration is in this case unable to sufficiently translate and rotate the crack growth reliability curve. In such a case it may be advisable to set the distance convergence criterion quite large. For two dimensional models, this does not seem to be a problem.

Profast only allows calibration of the parameters used exclusively in the crack growth model, and not on crack sizes. A constant value is listed with its name, while a random value is listed with its parameters. The possible selection is listed in the dialog box used for running the calibration and can be seen using a ? in line mode when prompted for the value.

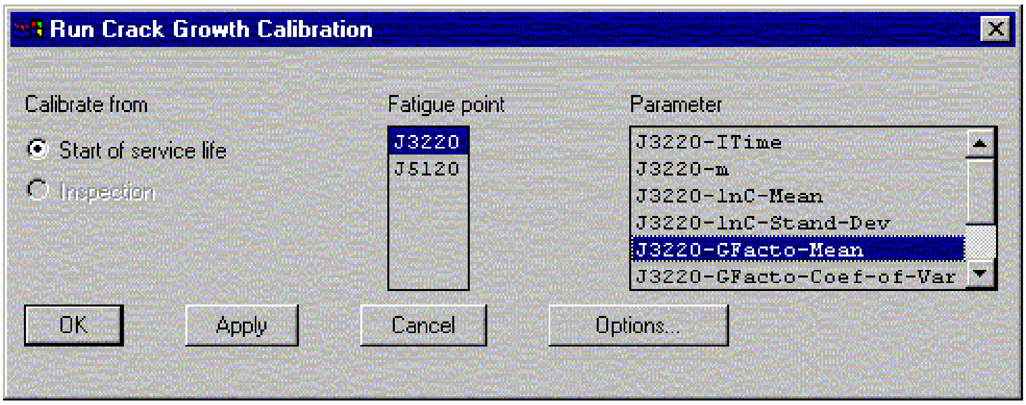


Figure 3.13 Dialog box for starting a crack growth calibration

When selecting parameters for calibration, please note the following:

- When two parameters are selected, it is usually a good choice to select one geometry function value (GFactor, acRatio, MSRatio etc.) and one crack growth model value (m, lnC etc.).
- For one dimensional crack growth models, the effect of selecting more than one parameter is usually not to improve the fit, but rather to spread the parameter changes onto more parameters.
- Some parameters may need to be fixed because of restrictions on the model.
- If a parameter with restricted variability is selected (e.g. standard deviation, coefficient of variation, a/c ratio, membrane stress ratio), the iteration process may temporarily try to give it an illegal value during the iteration, thus causing some warning messages. This is usually not a problem in achieving convergence. However, it is probably not a good idea to select only parameters with such restricted variability for the calibration.

The calibration result can be displayed and printed.

In this example, the factor on the geometry function is the only value used.

```
DEFINE CALIBRATION-CRACK-GROWTH TIME-POINTS ( ONLY 2000.5 2010.5 2030.5 )
RUN CALIBRATION-CRACK-GROWTH J3220
Parameter to be used in calibration (ONLY)? ?
     Available values (selected values are shown in parentheses):
     J3220-m                     J3220-lnC-Mean
```

```
     J3220-lnC-Stand-Dev        J3220-GFacto-Mean
     J3220-GFacto-Coef-of-Var   J3220-acRati-Mean
     J3220-acRati-Coef-of-Var   J3220-MSRati
Parameter to be used in calibration (ONLY)? J3220-GFacto-Mean
     Changed Variable : J3220-SNFail
     Changed Variable : J3220-CGFail
     Crack growth calibration for Fatigue point: J3220
     Parameter 1 : J3220-GFacto-Mean
     IT Parameter 1 2000.50 2010.50 2030.50  STEP   DIST
     -- ----------- ------- ------- ------- ------ -----
     SN    Not used   3.563   2.854   2.159 0.0010  0.300
      0   1.000E+00   1.166   0.566   0.000 2.2837  2.284
      1   2.250E-01   6.268   5.551   4.844 4.9782  2.695
      2   3.937E-01   4.268   3.580   2.905 1.9705  0.725
      3   4.767E-01   3.603   2.928   2.268 0.6511  0.079
      4   4.871E-01   3.529   2.855   2.197 0.0727  0.030
      5   4.872E-01   3.528   2.854   2.196 0.0009  0.029

     Required convergence achieved.
     Changed Variable J3220-GFacto to Normal( Mean-CoV: 0.487231, 0.1)
```

The result may be displayed using DISPLAY CALIBRATION-CRACK-GROWTH. Shown here is the result for the other fatigue point, J3220 together with a display of crack growth analysis after calibration. In this case, the fit is quite good. You may wish to compare with the calibration of a two dimensional crack growth model, Figure 2.6 on page 2-14.

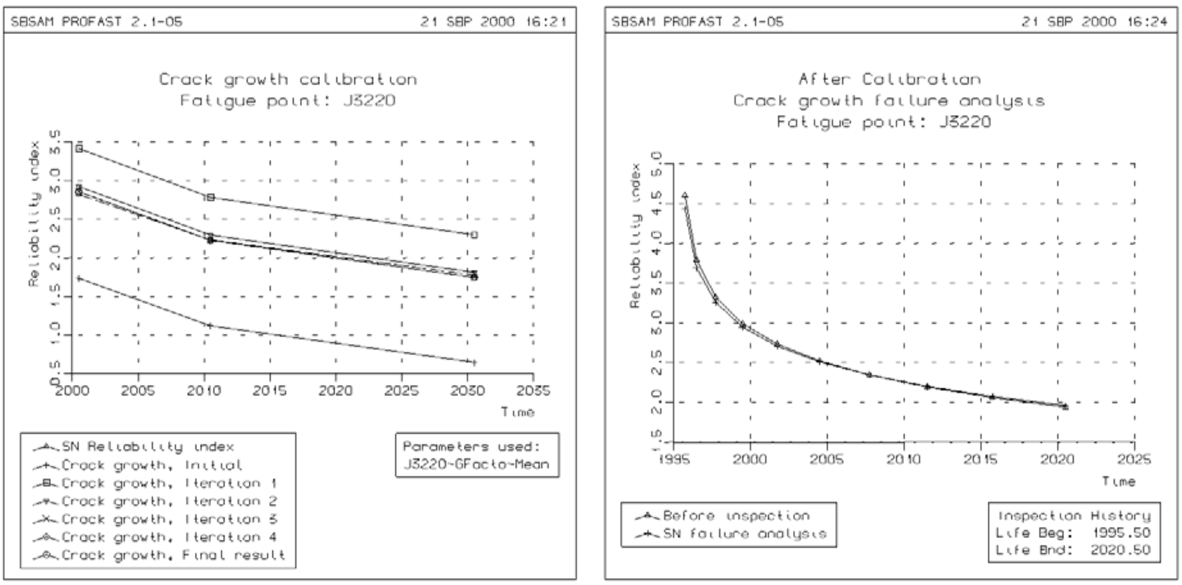


Figure 3.14 Result of crack growth calibration for a one dimensional crack growth model

These commands were used to generate the plots:

```
RUN CALIBRATION-CRACK-GROWTH J3220 ( ONLY J3220-GFactor-Mean )
SET DRAWING FONT-SIZE RELATIVE 1.5
DISPLAY CALIBRATION-CRACK-GROWTH J3220 ALL-ITERATIONS
RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220
SET TITLE 'After Calibration' ' ' ' ' ' '
DEFINE PRESENTATION CRACK-GROWTH-ANALYSIS SN-FAILURE ON
DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220 RELIABILITY-INDEX
```

3.7.3 Running a Crack Growth Analysis and Examination of Results

The command RUN CRACK-GROWTH-ANALYSIS is used. There are three options:

- Calculate the failure probability as a function of time
- Calculate the time to failure, deterministic or as a random distribution.
- Update the variables and events that are used in the analysis (see below).

In the graphics user interface, the pulldown menus "Crack-Growth -> Life time" and "Crack-Growth -> Failure probability" are used.

The crack growth analysis model is contained in two random variables and one event, with names derived from the name of the fatigue point, but abbreviated to 12 characters. In the case of the fatigue point J3220, these will be:

J3220-CGLife VARIABLE	Time to crack growth failure in years
J3220-CGFail VARIABLE	Limit state value (i.e. negative if failure, positive if safe).
J3220-CGFail EVENT	Failure event (i.e. J3220-SNFail < 0)

These variables and events will be updated when needed by an analysis, or when an update is specifically requested by RUN CRACK-GROWTH-ANALYSIS UPDATE-MODEL (see also Appendix B).

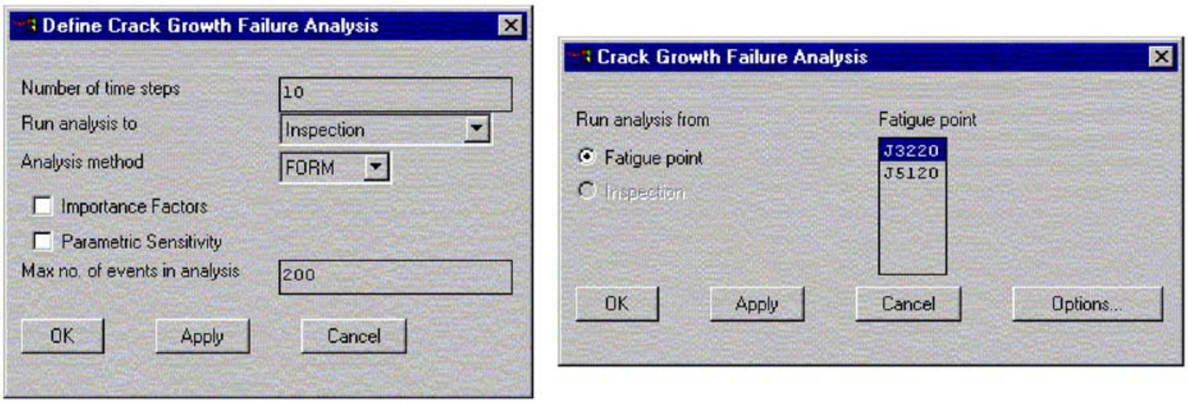


Figure 3.15 Dialog box for crack growth failure probability analysis and corresponding options

The analysis setup is defined through DEFINE CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY or through the DEFINE commands used to manipulate distribution analysis, e.g. DEFINE DISTRIBUTION-SIMULATION. Note that sensitivity analysis is turned off by default for probability analysis. This is to save computation time. It may however be informative to turn on importance factor calculation at least once to see the contribution each uncertainty makes to the failure probability. Note also that, when an inspection is created, it will be possible to start the crack growth analysis at the time of the inspection. The number of time steps in the failure probability analysis defines the number of crack growth analyses used to map the failure probability over time. If set to 1, the analysis is performed only at the end of the service life or at the inspection time, as appropriate.

The analysis method to be used for failure probability analysis is defined through DEFINE CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY METHOD or, if the DEFAULT option is selected, through the command SELECT ANALYSIS-METHOD PROBABILITY. The analysis method used for probabilistic life time analysis is defined using SELECT ANALYSIS-METHOD DISTRIBUTION.

The analysis results are stored with the names NAME-CGLife and NAME-CGFail respectively. The analysis results may be examined by use of PRINT/DISPLAY CRACK-GROWTH-ANALYSIS or, for a more detailed examination of one result, the commands SELECT RESULT followed by PRINT/DISPLAY RESULT may be used.

The following commands were used to generate these plots (note that the dominating uncertainty on log(K) was removed from the last plot to be able to discern the effect of the remaining values):

```
DEFINE CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY IMPORTANCE ON
RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220
SET DRAWING FONT-SIZE RELATIVE 1.5
SET TITLE 'After Calibration' ' ' ' ' ' '
SELECT RESULT J3220-CGFail
DISPLAY RESULT PARAMETER-STUDY IMPORTANCE *
SET DRAWING FONT-SIZE RELATIVE 1.3
DISPLAY RESULT IMPORTANCE ( 1995.8 2004.5 2020.5 )
```

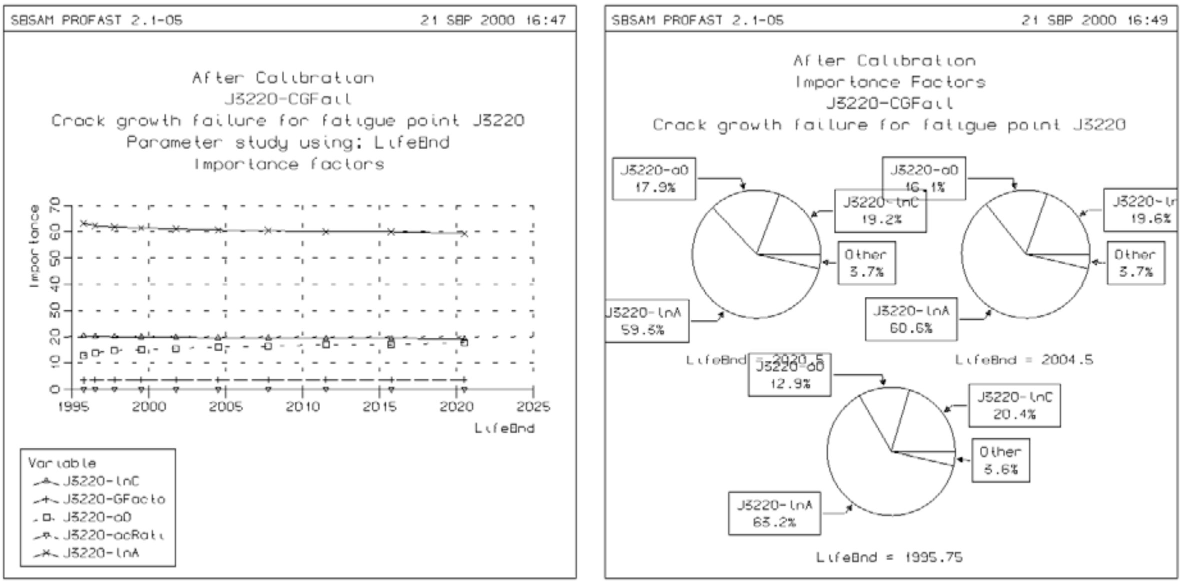


Figure 3.16 importance factor results from a crack growth failure analysis

3.8 Taking Inspections Into Account

The crack growth model formulation has one great advantage over the SN model: It contains an observable quantity, the crack size. Thus, it is possible to inspect the structure, measure the crack size if a crack was found, and formulate a conditional failure probability given this information.

In Profast, the user need not be concerned with the formulation of conditional probabilities. These are set up automatically when needed, e.g. in a crack growth analysis or during inspection planning. Instead, the user must supply the observed information at inspections, and assign uncertainty to the values as desired.

3.8.1 Inspection Events

In Profast, inspection observations can be modelled in the length and/or the depth direction. It is possible to model a crack in one direction (e.g. depth) and observe it in another (e.g. length), because the crack growth models have been formulated so that a depth/length conversion based on the a/c ratio is included when appropriate.

The following types of inspection results can be defined for depth and length:

1 No crack found, i.e. the inspection event is:

The crack size at the inspection time is smaller than the smallest detectable crack size.

2 A crack of unknown size was found, i.e. the inspection event is:

The crack size at the inspection time is greater than the smallest detectable crack size.

3 A crack was found and the size measured, i.e. the inspection event is:

The crack size at the inspection time is identical to the measured crack size.

4 A crack was found and the size known to be less than a given value, i.e. the inspection event is:

The crack size at the inspection time is less than the given crack size. This may for example be the case when the crack is ground away.

5 A crack was found and the size known to be greater than a given value, i.e. the inspection event is:

The crack size at the inspection time is greater than the given crack size.

6 No observation of this crack size was made.

The inspection events described above can be applied to a fatigue point using the command CREATE INSPECTION (inspections are available in the "Model -> Inspection" pulldown menu in the graphical user interface). Each inspection is given a name, which must be different from all other created fatigue point and inspection names. The information required is the inspection time and event, as well as the observed information for crack depth and crack length.

For example, an inspection of length at which the crack size was measured to 5mm:

```
CREATE INSPECTION J5-I1 'First inspection at J5120' J5120 1994.5
                         NOT-OBSERVED CRACK-FOUND EQUAL-TO 5
      Created Variable J5-I1-Time as fixed with value 1994.5
      Created Inspection J5-I1 at fatigue point J5120 at time 1994.5
      Depth inspection at J5-I1: Not Observed
      Created Variable J5-I1-Length as fixed with value 5.0
      Length inspection at J5-I1: Equal To 5.0
```

Inspections can be deleted but not changed. However, a grind repair can be added (see Section 3.8.4).

Note that during inspection planning, Profast may create future no-find inspections if needed in order to maintain the required target reliability. Such inspections are by default deleted when the planning is complete, but can be kept if desired (see also Section 3.9). If kept, they will be deleted if the inspection plan is deleted.

3.8.2 Inspection Quality

The quality of an inspection method is described by the smallest crack size that can be detected.

The smallest detectable crack size is typically modelled a random variable. The distribution of this random variable is called the POD curve (Probability Of Detection).

In the case of the first two inspection events, this value is needed. Depending on what was inspected, it must be specified for the depth, the length or both. An inspection quality to be applied in the future must also be specified before an inspection plan can insert no-find inspections when required, see also Section 3.9.

A number of POD curves are predefined (see Section 2.6). More can be defined, as they are simply modelled as random variables (using CREATE/CHANGE VARIABLE, note that data fit is available). For easy access, it is recommended to prefix the names of length POD curves with PODL- and names of depth POD curves with PODD-.

For example: (these distributions are arbitrarily defined, and are not recommended in general):

```
CREATE VARIABLE PODL-Visual 'Visual Inspection quality, Length'
                            DISTRIBUTION EXPONENTIAL Mean-Low 6 0
CREATE VARIABLE PODD-Visual 'Visual Inspection quality, Depth'
                            DISTRIBUTION EXPONENTIAL Mean-Low 2 0
```

Each time a POD curve is applied to an inspection, it is referenced as a distribution generated from the original POD curve variable. You do not need to understand this in detail, but the implications are, that all POD curves based on the same POD variable are stochastic independent and use the same distribution definition. So, if the original POD curve variable is changed, all applications of the POD curve will be affected.

3.8.3 Crack Growth Analysis After Inspection

The command RUN CRACK-GROWTH-ANALYSIS is used. The possibilities are the same as described in Section 3.7.3. However, a life time analysis that starts before the time of the inspection, will not take the inspection into account, and a life time analysis for a inspection will ignore any later inspections.

A failure probability analysis will take all inspections into account from the start of the analysis and to the end of the service life. A new analysis is done after each inspection, because new information must be taken into account, thus resulting in a new conditional failure probability.

When an inspection is created, the following random variables and events are maintained by Profast when needed by an analysis, or when an update is specifically requested by RUN CRACK-GROWTH-ANALYSIS UPDATE-MODEL (assuming an inspection named NAME, see also Appendix B):

NAME-InDep	VARIABLE	Depth inspection variable, if crack depth was observed.
NAME-InDep	EVENT	Depth inspection event, if crack depth was observed.
NAME-InLen	VARIABLE	Length inspection variable, if crack length was observed.
NAME-InLen	EVENT	Length inspection event, if crack length was observed.
NAME-InAll	EVENT	Intersection of all inspection events up to this time
NAME-CGFail	VARIABLE	Failure margin variable during remaining lifetime
NAME-CGFail	EVENT	Failure event during remaining lifetime
NAME-CGLife	VARIABLE	Time to crack growth failure in years

After the analysis is completed, these variables and events will be available to the user if the need for a special analysis arises.

3.8.4 Taking Repair Into Account

When an inspection is performed, it is by default assumed that no repair is performed. However, the command ASSIGN REPAIR may be used to implement a grind repair.

These actions are performed automatically when the ASSIGN REPAIR command is used:

1 The start time for the event of failure after the inspection, and for any future inspection event margins, is set to the inspection time.

2 The SN model assignments, crack growth model parameters and geometry function parameters are copied to new variables (independent, identically distributed). No weld effect is assigned after a grind repair.

3 The thickness of the material is reduced with the grind depth. The critical crack depth is unchanged. However, a critical crack depth greater than the thickness is simply treated as being equal to the thickness during analysis.

4 Assignment of CRACK-GROWTH-MODEL, GEOMETRY-FUNCTION, INFLUENCE-COEFFICIENTS, SCF, SN-CURVE, STRESS-RANGE, TRANSFER-FUNCTION and WELD-EFFECT to the inspection is now possible. The effect of such an assignment is to change the assigned value from the time of the inspection.

Note that the stress range assignment is not changed. This may be done if desired. Note also that change of e.g. SCF values does not implicitly change the stress range. The ASSIGN STRESS-RANGE command must subsequently be used.

For example, assuming a grind was made at the crack discovered earlier:

```
ASSIGN REPAIR J5-I1 GRIND 2
      Created Variable J5-I1-Grind as fixed with value 2.0
      Created Variable J5-I1-Thick as fixed with value 18.0
      Grind repair to depth 2.0 performed at inspection J5-I1
      Created Variable : J5-I1-GThick
      Changed Variable J5-I1-Thick to be identical to J5-I1-GThick
      SN curve DNVX assigned to J5-I1
      Created Variable J5-I1-MinerS as Normal( Mean-CoV: 1.0, 0.1)
      Created Variable J5-I1-ITime as fixed with value 0.0
      Created Variable J5-I1-m as fixed with value 3.5
      Created Variable J5-I1-lnC as Normal( Mean-StD: -31.0, 0.77)
      Created Variable J5-I1-GFacto as Normal( Mean-CoV: 0.545654, 0.1)
      Created Variable J5-I1-a0 as Exponential( Mean-Low: 0.1, 0.0)
      Created Variable J5-I1-acrit as fixed with value 20.0
      Created Variable J5-I1-acRati as Normal( Mean-CoV: 0.1, 0.1)
      Created Variable J5-I1-MSRati as fixed with value 0.2
```

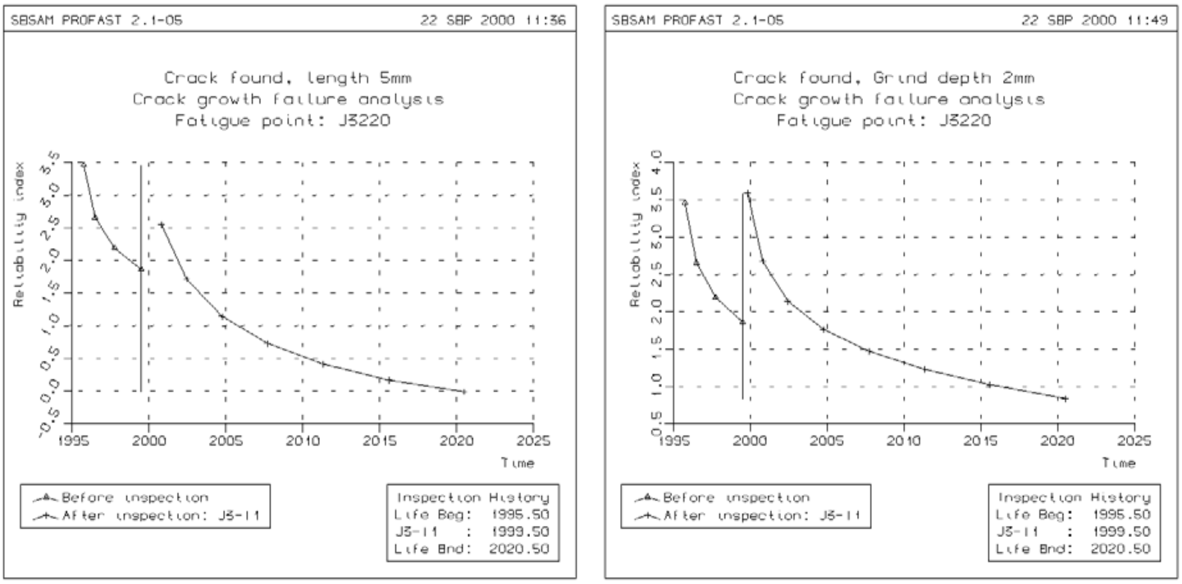


Figure 3.17 Crack growth failure analysis after inspection with and without grind repair

The effect of a grind repair is typically to increase the reliability of the structure significantly compared with the reliability after a crack was found.

These commands exemplify the finding of a crack of length 5mm and the subsequent grind to the depth of 2mm, and were used to create the plots:

```
CREATE INSPECTION J3-1 'First inspection at J3220' J3220 1999.5
                        NOT-OBSERVED CRACK-FOUND EQUAL-TO 5
DEFINE UNCERTAINTY Inspection-Length Normal NONE
                                        NOT-USED NOT-USED NOT-USED .01 .05 .1
ASSIGN UNCERTAINTY VALUE J3-I1-Length STDV 0.2
RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220
SET TITLE 'Crack found, Length 5mm' ' ' ' ' ' '
SET DRAWING FONT-SIZE RELATIVE 1.5
DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220 RELIABILITY-INDEX
ASSIGN REPAIR J3-1 GRIND 2
DEFINE UNCERTAINTY Inspection-Grind Normal NONE
                                       NOT-USED NOT-USED NOT-USED .01 .05 .1
ASSIGN UNCERTAINTY VALUE J3-I1-Grind STDV 0.2
RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220
SET TITLE 'Crack found, Grind depth 2mm' ' ' ' ' ' '
DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220 RELIABILITY-INDEX
```

3.9 Planning Future Inspections

The purpose is to plan inspections of the critical points (fatigue points) in a cost-efficient manner while still maintaining the required reliability for each point.

In order to make this possible, Profast offers two planning methods:

- Prescribed times:

  This method is used when inspections are known to be performed at certain prescribed points in time. The plan will be constructed, if possible, such that the reliability of each fatigue point never falls below the required reliability.

- Optimised times:

  This method is used when inspections can wait until absolutely necessary. The plan will be constructed so that each fatigue point is inspected when its reliability is identical to the required reliability. This will typically require fewer inspections than the inspection at prescribed times, but require more flexibility in the execution of the inspections.

The dialog boxes used to set up, execute and present an inspection plan are found in the graphics user interface in the "Plan" pulldown menu.

3.9.1 Setting up the Plan

In order to be able to decide when inspections are needed, a reliability target value β_{target} must be specified for each fatigue point. The reliability at each point is not allowed to go below this target value. The target reliability is specified using the command ASSIGN TARGET-RELIABILITY.

For a proper choice of the target reliability, appropriate rules, guidelines and design codes should be consulted. The choice of target reliability is not a subject for this manual, because it may involve evaluation of the different failure consequences (e.g. loss of life, economical). However, for convenience three possible approaches are outlined here:

1 Specific values are applied, depending on the type and consequence of failure of the member.

2 The target reliability for a member could be established by defining a maximal allowed SN fatigue damage level for the member, and setting the target reliability to the SN fatigue reliability for not exceeding this damage level.

3 The target reliability for a member could be established through redundancy analyses by comparing the failure probability of the structure before and after collapse of the member.

When planning inspections over the whole service life, it is standard practice to assume that inspections will be performed in the future when needed, and with the result that no crack is found. In order to be able to do this, an inspection quality (POD curve) to be used in the future must be defined. If this inspection quality is not defined, Profast will only be able to plan one inspection into the future. This is done by use of ASSIGN INSPECTION-QUALITY.

There are two other cases, where it will be impossible to plan more than one inspection ahead:

1 If an inspection already has been modelled after the starting time of the plan.

2 In a crack has been found before the starting time of the plan, and it has not been ground away.

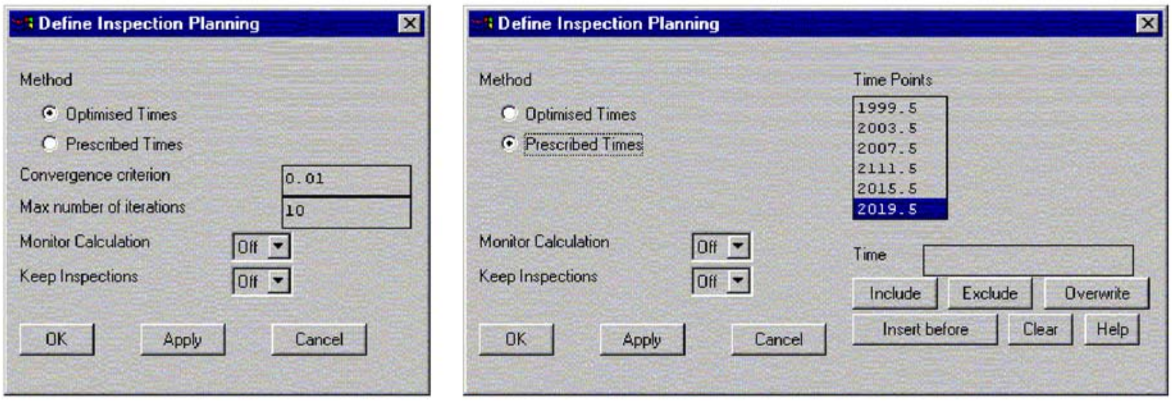


Figure 3.18 Dialog box for definition of optimised and prescribed inspection plan

The command DEFINE PLAN-INSPECTION is used to define the type of inspection plan and any prescribed inspection times. In addition, it is possible to specify if the convergence criterion for the optimised plan, decide if the reliability calculation should be monitored and decide if any planned inspections should be kept (see Figure 3.18).

3.9.2 Calculating the Inspection Plan and Examination of the Plan

The command RUN PLAN-INSPECTIONNING is used to actually create the plan. A number of fatigue points can be selected for inclusion in the plan. The plan is given a starting time, a name and a descriptive text. The name is used to access the plan for presentation and if it is to be deleted. All existing inspections up to and including the starting time are automatically taken into account.

As the number of probabilistic analyses is quite large, the planning process can take some time.

These are responses from Profast when making an optimised plan and a prescribed plan using the example fatigue points. In the last case, monitoring of the reliability index calculation is turned on:

```
ASSIGN TARGET-RELIABILITY J3220 LIFETIME-RELIABILITY 3.5
      Assigned target reliability 3.5 to J3220
ASSIGN TARGET-RELIABILITY J5120 LIFETIME-RELIABILITY 3.0
      Assigned target reliability 3.0 to J5120
ASSIGN INSPECTION-QUALITY ( ONLY J3220 J5120 ) LENGTH PODL-MPI-UW
      Assigned inspection quality: PODL-MPI-UW (Length) to J3220
      Assigned inspection quality: PODL-MPI-UW (Length) to J5120
RUN PLAN-INSPECTION ( ONLY J3220 J5120 ) 1990.5 OPT 'Optimised plan'
     Calculating inspection plan OPT for 2 fatigue points using Optimised
     times
      J3220   : Inspection at 2000.80 when reliability is   3.499
      J3220   : Inspection at 2007.44 when reliability is   3.490
      J3220   : Inspection at 2015.66 when reliability is   3.496
      J5120   : Inspection at 1993.66 when reliability is   2.990
      J5120   : Inspection at 1995.85 when reliability is   2.998
```

```
      J5120   : Inspection at 1998.69 when reliability is   2.992
      J5120   : Inspection at 2002.15 when reliability is   2.999
      J5120   : Inspection at 2006.34 when reliability is   2.990
      J5120   : Inspection at 2011.12 when reliability is   2.999
      J5120   : Inspection at 2016.65 when reliability is   2.992
DEFINE PLAN-INSPECTION METHOD PRESCRIBED ( GROUP 1994.5 2018.5 4 2020.5 )
DEFINE PLAN-INSPECTION MONITOR-CALCULATION ON
DEFINE PLAN-INSPECTION KEEP-INSPECTIONS ON
RUN PLAN-INSPECTION ( ONLY J3220 J5120 ) 1990.5 PRE
                                         'Inspection every fourth year'
    Calculating inspection plan PRE for 2 fatigue points using 8 Prescribed  times
      J3220   : Beta =   4.439 at 1994.50
      J3220   : Beta =   3.748 at 1998.50
      J3220   : Beta =   3.349 at 2002.50
      J3220   : Inspection at 1998.50 when reliability is   3.748
      J3220   : Created length inspection: J3220-1: No Crack Found
      J3220   : Beta =   3.843 at 2002.50 conditioned on  1 inspection
      J3220   : Beta =   3.467 at 2006.50 conditioned on  1 inspection
      J3220   : Inspection at 2002.50 when reliability is   3.843
      J3220   : Created length inspection: J3220-2: No Crack Found
      J3220   : Beta =   3.990 at 2006.50 conditioned on  2 inspections
      J3220   : Beta =   3.625 at 2010.50 conditioned on  2 inspections
      J3220   : Beta =   3.376 at 2014.50 conditioned on  2 inspections
      J3220   : Inspection at 2010.50 when reliability is   3.625
      J3220   : Created length inspection: J3220-3: No Crack Found
      J3220   : Beta =   3.990 at 2014.50 conditioned on  3 inspections
      J3220   : Beta =   3.662 at 2018.50 conditioned on  3 inspections
      J3220   : Beta =   3.541 at 2020.50 conditioned on  3 inspections
      J5120   : Beta =   2.763 at 1994.50
      J5120   : Inspection at 1994.50 when reliability is   2.763
      J5120   : CANNOT MAINTAIN TARGET RELIABILITY:   3.000 at time 1994.50
      J5120   : Created length inspection: J5120-1: No Crack Found
      J5120   : Beta =   2.580 at 1998.50 conditioned on  1 inspection
      J5120   : Inspection at 1998.50 when reliability is   2.580
      J5120   : CANNOT MAINTAIN TARGET RELIABILITY:   3.000 at time 1998.50
      J5120   : Created length inspection: J5120-2: No Crack Found
      J5120   : Beta =   2.688 at 2002.50 conditioned on  2 inspections
      J5120   : Inspection at 2002.50 when reliability is   2.688
      J5120   : CANNOT MAINTAIN TARGET RELIABILITY:   3.000 at time 2002.50
      J5120   : Created length inspection: J5120-3: No Crack Found
      J5120   : Beta =   2.846 at 2006.50 conditioned on  3 inspections
      J5120   : Inspection at 2006.50 when reliability is   2.846
      J5120   : CANNOT MAINTAIN TARGET RELIABILITY:   3.000 at time 2006.50
      J5120   : Created length inspection: J5120-4: No Crack Found
      J5120   : Beta =   3.001 at 2010.50 conditioned on  4 inspections
      J5120   : Beta =   2.569 at 2014.50 conditioned on  4 inspections
      J5120   : Inspection at 2010.50 when reliability is   3.001
      J5120   : Created length inspection: J5120-5: No Crack Found
      J5120   : Beta =   3.140 at 2014.50 conditioned on  5 inspections
      J5120   : Beta =   2.710 at 2018.50 conditioned on  5 inspections
      J5120   : Inspection at 2014.50 when reliability is   3.140
      J5120   : Created length inspection: J5120-6: No Crack Found
```

```
      J5120    : Beta =   3.262 at 2018.50 conditioned on  6 inspections
      J5120    : Beta =   3.022 at 2020.50 conditioned on  6 inspections
```

Note that the prescribed inspection interval is too long for the point at joint 5120. Given these times, there is no way that inspections can be planned such that the required target reliability is maintained.

This also becomes evident when the plans are printed. Plans can be printed showing the inspections in chronological order, or fatigue point by fatigue point:

```
PRINT PLAN-INSPECTION OPT POINTWISE
Inspection plan : OPT
Description     : Optimised plan
Method          : Inspect when target reliability is reached
Start Time      : 1990.50
End Service Life: 2020.50
FatigPnt Target Reliab   Time  POD Curve    Dir Remark
-------------------------------------------------------------------------------
J3220     3.500  3.499 2000.80 PODL-MPI-UW  Len Jnt 3220
                 3.490 2007.44 PODL-MPI-UW  Len
                 3.496 2015.66 PODL-MPI-UW  Len
J5120     3.000  2.990 1993.66 PODL-MPI-UW  Len Jnt 5120
                 2.998 1995.85 PODL-MPI-UW  Len
                 2.992 1998.69 PODL-MPI-UW  Len
                 2.999 2002.15 PODL-MPI-UW  Len
                 2.990 2006.34 PODL-MPI-UW  Len
                 2.999 2011.12 PODL-MPI-UW  Len
                 2.992 2016.65 PODL-MPI-UW  Len
PRINT PLAN-INSPECTION PRE CHRONOLOGICAL
Inspection plan : PRE
Description     : Inspection every fourth year
Method          : Inspect only at prescribed times
Time points     : 1994.50 1998.50 2002.50 2006.50 2010.50 2014.50
                  2018.50 2020.50
Start Time      : 1990.50
End Service Life: 2020.50
FatigPnt Target Reliab Time    POD Curve   Dir Remark
------------------------------------------------------------------------------
J5120     3.000  2.763 1994.50 PODL-MPI-UW  Len Jnt 5120. BELOW TARGET!
J3220     3.500  3.748 1998.50 PODL-MPI-UW  Len Jnt 3220
J5120     3.000  2.580 1998.50 PODL-MPI-UW  Len Jnt 5120. BELOW TARGET!
J3220     3.500  3.843 2002.50 PODL-MPI-UW  Len Jnt 3220
J5120     3.000  2.688 2002.50 PODL-MPI-UW  Len Jnt 5120. BELOW TARGET!
J5120     3.000  2.846 2006.50 PODL-MPI-UW  Len Jnt 5120. BELOW TARGET!
J3220     3.500  3.625 2010.50 PODL-MPI-UW  Len Jnt 3220
J5120     3.000  3.001 2010.50 PODL-MPI-UW  Len Jnt 5120
J5120     3.000  3.140 2014.50 PODL-MPI-UW  Len Jnt 5120
```

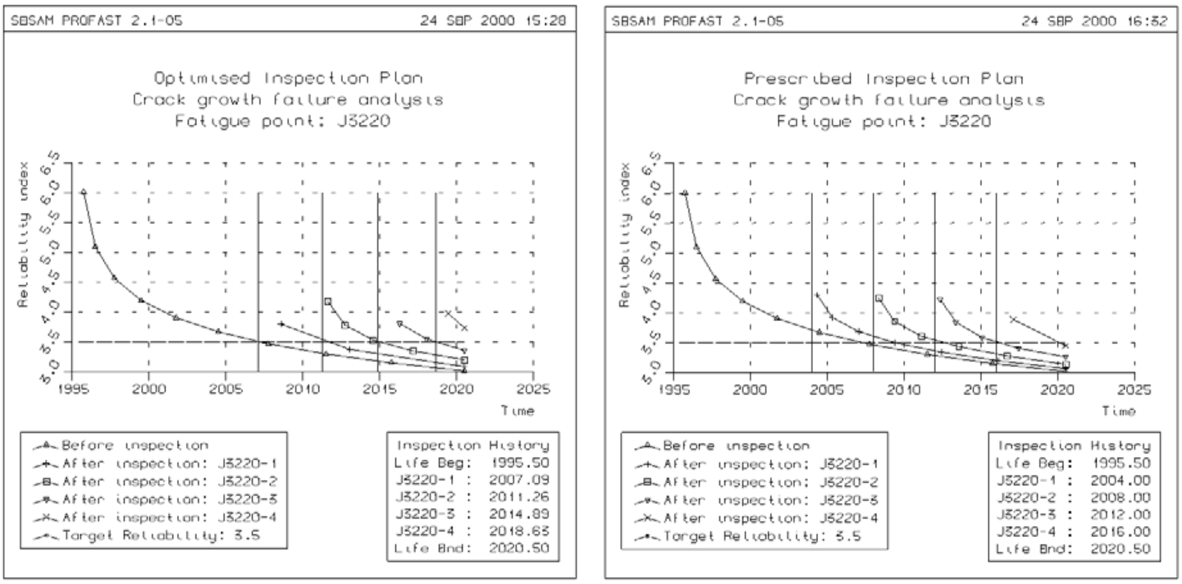


Figure 3.19 Planned crack growth reliability curve

If the inspections are kept (see DEFINE PLAN-INSPECTION KEEP-INSPECTIONS), it becomes possible to calculate the predicted failure probability as a function of time for each fatigue point, taking the planned inspections into account (see the figure above, and also Figure 2.7):

Such inspections must be deleted before another plan for the same fatigue point can be calculated. Deleting an inspection plan will automatically delete all inspections created by the plan.

3.10 Advanced Usage of Profast

This section describes some facilities, that require some knowledge about probabilistic methods and in some cases specific manipulations on the part of the user.

3.10.1 Probabilistic and Deterministic Analysis and Result Presentation

The RUN command (the Analysis menu in the graphical user interface) gives access to direct analysis of random variables and events. The following types of analysis are available:

- Deterministic analysis

  Calculates the value of a random variable and all variables on which it depends.

- Probability analysis

  Calculates the probability of an event, possibly conditioned on another event.

- Distribution analysis

Calculates the distribution of a random variable, possibly conditioned on an event.

In all three cases, the result can be calculated for different values of a parameter, see DEFINE PARAMETER-STUDY. This is automatically done in the SN and crack growth failure probability analysis.

Each such analysis is stored under a name, and is accessible as a RESULT, e.g. through PRINT RESULT or through the Result menu in the graphical user interface. The result is by default named: LastAnalysis. This name can be changed after the analysis is completed by saving the result under another name, using SAVE RESULT. If not saved, the result will be over written the next time an analysis is run.

In order to be presented using PRINT or DISPLAY, the result must be selected, using SELECT RESULT. When an analysis is run, the result is automatically selected.

The SN and crack growth analysis use these analysis and result facilities. In these cases, the results are saved under names derived from the fatigue point or inspection being analysed (e.g. J3220-SNFail). These results are automatically accessible when PRINT/DISPLAY SN-ANALYSIS or PRINT/DISPLAY CRACK-GROWTH-ANALYSIS commands are executed. The results are, however, accessible directly by use of SELECT RESULT followed by PRINT and/or DISPLAY commands. This may be useful for examining details that are not available through other commands. See for example the commands leading to Figure 3.16.

A number of commands are available for setting up these analysis. In the graphics user interface, they are available in the Analysis menu (see also Section 5.1.8):

- SELECT ANALYSIS-METHOD

  Select the method used for probability and distribution analysis

- DEFINE ANALYSIS-OPTION

  Set a number of general analysis options

- ASSIGN SENSITIVITY VARIABLE

  Decide which for which parameters sensitivity analysis is performed

- ASSIGN SENSITIVITY INCREMENT

  Set parameter increments to be used for sensitivity analysis

- DEFINE PARAMETER-STUDY

  Define the parameter to be used and set the values

- DEFINE FORM-SORM

  Set a number of general options for FORM and SORM analysis

- ASSIGN OPTIMISATION-BOUNDS

  Assign bounds for variables during FORM/SORM analysis.

- ASSIGN STARTING-POINT

  Set starting point for variables and events to be used in a FORM/SORM analysis.

- DEFINE FORM-SORM GENERATED-DISTRIBUTIO

Set options for calculation of generated distributions.

- DEFINE PROBABILITY-SIMULATION AXIS-ORTHOGONAL

  Set options for axis-orthogonal simulation of a probability.

- DEFINE PROBABILITY-SIMULATION DIRECTIONAL

  Set options for directional simulation of a probability.

- DEFINE PROBABILITY-SIMULATION MONTE-CARLO

  Set options for Monte Carlo simulation of a probability.

- DEFINE DISTRIBUTION-SIMULATION

  Set options for simulation of a distribution.

- DEFINE MEAN-VALUE-FORM

  Set options for mean value based FORM calculation of a distribution.

- In addition, the DEFINE SN-ANALYSIS and DEFINE CRACK-GROWTH-ANALYSIS commands are available. The settings available here will override any other settings when these analyses are performed.

For a summary of the available commands for manipulation of results, see the command description of PRINT RESULT and DISPLAY RESULT and Section 5.1.9.

3.10.2 Modelling Events

There is generally not a large need for modelling events directly in Profast. The program maintains a number of events itself, in order to be able to execute the required SN and crack growth analyses (these are write protected and cannot be changed by the user). However, when required, the commands CREATE/ CHANGE EVENT can be used.

The following types of events are available:

- SINGLE-EVENT

  The event is specified as a random variable being equal to, less than or greater than a numerical value.

- INTERSECTION

  The event is the intersection of a number of other events. The event is fulfilled if and only if each sub event is fulfilled.

- UNION

  The event is the union of a number of other events. The event is fulfilled if and only if at least one subevents is fulfilled.

- CONDITIONED

  The event is used in the RUN PROBABILITY-ANALYSIS CONDITIONED command to conveniently specify a conditioned analysis. It contains a conditioned event and an event conditioned on.

3.10.3 Updating on Inspection at Another Fatigue Point

This section gives a specific example of how the events maintained by Profast can be used to perform an analysis, that is not directly available in the program: To calculate the conditional crack growth failure probability for one fatigue point given information gained at another fatigue point.

A-CGFail	Failure of fatigue point A during the service life.
A1-InLen	The inspection event for fatigue point A.
A1-InAll	The intersection of all inspections done on A up to the time of inspection A1.
B-CGFail	Failure of fatigue point B during the service life.

If desired, the variables defining the different events can be correlated using ASSIGN CORRELATION.

The desired probability can then be found by using these commands:

```
RUN CRACK-GROWTH-ANALYSIS UPDATE-MODEL A
RUN CRACK-GROWTH-ANALYSIS UPDATE-MODEL B
RUN PROBABILITY-ANALYSIS CONDITIONED B-CGFail A1-InAll
```

The result can be examined using PRINT RESULT, see also Section 3.10.1 for a closer description of how to handle such analyses and examine the results. Note that the UPDATE-MODEL command is used to make sure that the events used in the following analysis are correctly defined.

To complicate matter further, assume that an extra inspection has been done at point A with a measured crack found (named A2), and a similar inspection has been done at point B (named B1). This may generate the following events:

A2-InLen	The second inspection event for fatigue point A.
A2-InAll	The intersection of both inspection events at point A.
B1-InLen	The inspection event for fatigue point B.
B1-InAll	The intersection of all inspections done on B up to the time of inspection B1.

The failure probability for B given the inspections both at point A and B can be found using these commands:

```
RUN CRACK-GROWTH-ANALYSIS UPDATE-MODEL A
RUN CRACK-GROWTH-ANALYSIS UPDATE-MODEL B
CREATE EVENT B-InspAB 'Inspection at A and B' INTERSECTION ( A2-InAll B1-InAll )
RUN PROBABILITY-ANALYSIS CONDITIONED B-CGFail B-InspAB
```

Note that it is necessary to explicitly create the conditioning event, as it contains information from both A and B and is therefore not maintained by Profast.

3.10.4 Systems Reliability

Profast does not handle systems reliability calculations by itself. It is up to the user to formulate the system failure event, and to make sure that it is correctly modelled. However, the failure events that are created by Profast during the analysis of each fatigue point may be reused for this purpose.

Thus, after an inspection analysis it may be possible to use the CREATE EVENT command to set up a system reliability event, e.g. as a union of some of the failure events created by Profast. The ASSING CORRELATION command may be used to correlate random variables that are present in different failure events (e.g. loads). The RUN PROBABILITY-ANALYSIS command may then be used to calculate the systems failure probability, and the PRINT/DISPLAY RESULT commands to examine the results.

For this type of analysis, Profast dose not offer the same type of assistance in the form of automated analysis preparation and result presentation as it does for e.g. crack growth analysis of a fatigue point. However, the tools are there, and it is up to the user to employ them to full effect.

3.11 Various Hints

This section contains various hints on how to facilitate the use of Profast.

3.11.1 Importing Plot Files Into Documents

Profast will orient postscript plots along the long edge of the paper. Thus, if a postscript plot produced by Profast is imported into a document and is intended to be presented with text (as in this manual), it will most likely be oriented in the wrong direction.

Some word processors cannot rotate such a picture. If you have this problem, use the following procedure instead:

1 Write the plot file in SESAM-NEUTRAL format.

2 Use the program PLTCNV_EXT, which is delivered with Profast, to convert it to another format. The input to PLTCNV_EXT will be:

```
SCALE = 0.9
OUTPUT-FILE-NAME=<the proper file name>
<input_file>.PLO
<output_format>
EXIT
```

   For the list of proper output formats, run PLTCNV_EXT interactively (Postscript is PSCR).

For documents maintained on a PC, the CGM or HPGL-7550 format may be more suitable than Postscript (the latter format is e.g. recognised by MS-Word when renamed to have a .HGL suffix). However, if such a file is written when running VMS, it cannot be imported directly into a PC document because of file format differences between VMS and DOS. In this case, it is better to write a file in SESAM-NEUTRAL format, and then use PLTCNV_EXT to convert it (as above), using HP70 as the output format. During this conversion, the SCALE command is not needed, and NO-ROTATE should be used instead.

Please note that it is necessary to write one plot only to each plot file that is to be imported into a word processor.

3.11.2 The Required Plot Format is not Available

If the plot format required by your printer/plotter is not available in the SET PLOT FORMAT command, you can try the following:

1 Write the plot file in SESAM-NEUTRAL format.

2 Use the program PLTCNV_EXT, which is delivered with Profast, to convert it to another format.

This program includes several formats that are not available in Profast. However, the extra formats are not tested and supported as well as the formats included in Profast itself.

3.11.3 Problems with Convergence During FORM/SORM Analysis

In some cases, especially when inspections are used, the calculation of the reliability index using FORM or SORM fails. There are basically two things that can go wrong:

1 The search for the design point(s) fails.

In this case, Profast will display a message stating that the linearisation of the design point has failed. A possible remedy is to change the convergence criterion to a larger value, using the command:
DEFINE FORM-SORM OPTIMIZATION SQP.

2 The calculation of the multinormal probability fails.

In this case, the design point(s) have been found and the linearisation completed, but the resulting failure set is of a form so that the probability content of the set cannot be calculated. It might help in this case to change the convergence criterion to a smaller value, using the same command as above.

There is also the possibility that the event used in the analysis has probability zero or one because of a problem in the model.

In some cases Profast will take steps to automatically adjust a parameter defining the form of the limit state function, in order to attempt to obtain a solution. This may happen during inspection planning, or during a crack growth analysis. As this is done automatically, there is usually no need to adjust this parameter manually. However, if you are familiar with limit state function formulations and wish to try, here is how it is done: The parameter is be accessible as a function option assigned to all crack growth failure variables and inspection events, as well as to the PFS-CGFail limit state function. The relevant function options are

Power-2DI	For inspection limit states where a POD curve is used. This value should not be less than 1 in order to contract the function for small values. To change it use the following command, where <name> is the name of the inspection limit state variable: ASSIGN FUNCTION-OPTION VARIABLE <name> Power-2DI <value>
Power-LSV	For all other crack growth limit states. This value should not be greater than 1 in order to stretch the function for small values and contract it for large values. To change it, use the following command: ASSIGN FUNCTION-OPTION FUNCTION PFS-CGFail Power-LSV <value>

The shape of the limit state function may be determined using a simulation of the distribution, or a deterministic analysis of the limit state variable combined with a parameter study.

Finally, if no equality events (i.e. inspections with known crack size) are involved, directional simulation may be attempted. This will take much more time. In order to switch to this, two commands must be used. The first commands allows the second to take effect during crack growth analysis.

```
DEFINE CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY ANALYSIS-METHOD DEFAULT
SELECT ANALYSIS-METHOD PROBABILITY-ANALYSIS DIRECTIONAL-SIMULATION
```

Monte Carlo simulation will in general not be useful, because the probability values are too small.

4 EXECUTION OF PROFAST

Profast may be run in three different modes:

- In interactive line mode, using only character based input. The line mode facilities are described in sSection 4.4
- In interactive graphics mode with menus and dialog boxes, where input may be given using a mouse as well as the keyboard. The interactive graphics mode facilities are described in Section 4.5, but in addition this mode also gives access to the line mode facilities. It requires a works tat ion or an X-terminal running the OSF/MOTIF window system
- In batch mode, which uses the line mode syntax and facilities.

The start up of Profast in the three different modes is described in Section 4.1. This section also describes the files that Profast uses.

The program requirements and limitations are described in Section 4.2 and Section 4.3.

4.1 Program Environment

Profast accesses may access a database produced by Framework, and with it a SESAM Results Interface File on direct access (SIN) format. See Section 4.1.6 for details about how to start up Profast with a Framework database.

Profast is delivered as one or two executables (depending on the computer system). The executables can be used under different conditions:

The basic version can only run line mode. It contains the X Windows graphics driver. This version can be run on a computer that has X Windows, but does not have Motif installed. This version is delivered only on VMS systems.

The MOTIF version has all capabilities. It can run both graphics and line mode. This version must run under the Motif window manager.

How to start the program in the different modes is described below.

4.1.1 Command Line Arguments

It is possible to specify command line arguments when starting Profast.

On VMS, the program an assignment of the following type must be done:

```
$PROFAST_MOTIF :== $ SESAM:PROFAST_MOTIF.EXE
```

Command line arguments may then be added to the alias activating the program, e.g.:

```
$ PROFAST_MOTIF /NOHEADER/STAT=OLD/INT=LINE/C-F=test_in.jnl/FORCED-EXIT
```

On other systems, the command line arguments are simply added to the usual command starting the program:

```
prompt> profast /NOHEADER/STAT=OLD/INT=LINE/C-F=test_in.jnl/FORCED-EXIT
```

Please note that:

1 Command line arguments and values can be abbreviated, as described in Section 4.4.4. However, other input will be accepted, and used when possible.

2 Each argument name must begin with a slash (/), and each argument value must be prefixed by an equal sign (=). Spaces can be freely distributed around the equal sign and before each slash.

3 Texts with blank space and special characters (e.g. file names) can be protected in quotes. Please note that some operating systems change the case of the input text if it is not protected in quotes.

4 If at least one of /PREFIX, /NAME and /STATUS is specified, the prompt for database and journal file file name is disabled, and defaults are used for any unspecified values.

5 Profast will issue a message when an error is found in the command line specification.

Table 4.1 Command line arguments

/HEADER=value	Give the usual start-up header (SHORT) or no start-up header (NONE).
/NOHEADER	same as /HEADER=NONE
/PREFIX=prefix	Specifies the database and journal file prefix
/NAME=name	Specifies the database and journal file name
/STATUS=status	Specifies the database and journal file status as OLD or NEW
/INTERFACE=LINE	Start the program in line mode, ignoring the graphics user interface.
/INTERFACE=WINDOW	Start the program in graphics mode.

Table 4.1 Command line arguments

/COMMAND-FILE=filename	Read the specified command input file just after the database has been opened and initialised.
/NOCOMMAND-FILE	Do not read an initial command input file.
/FORCED-EXIT	Exit Profast after the database has been opened and initialised, and any initial command file has been read.
/NOFORCED-EXIT	Disable the forced exit.
/COMPANY-NAME=value	Specifies the header in the display (see also SET COMPANY-NAME)
/EYEDIR-X=value /EYEDIR-Y=value /EYEDIR-Z=value	Specifies the initial eye direction for display of the imported structure. When the first value is specified, the remaining are initialised to zero.
/PRINT-FORMFEED=value	Use FORTRAN or ASCII form feed character on LIS files.
/PLOT-COLOUR=value	Specifies the plot colour (see also SET PLOT COLOUR).
/PLOT-FORMAT=format	Specifies the plot file format (see also SET PLOT FORMAT).
/PLOT-PAGE-SIZE=value	Specifies the plot page size (see also SET PLOT PAGE-SIZE).

4.1.2 Starting Profast in Graphics Mode

To start Profast in graphics mode, the computer must be running under the Motif window manager.

Profast reads a resource file with the name FACEITCLASS.DAT (on VAX/VMS) and faceitClass (on Unix systems, note the use of upper- and lower case letters). this file is placed in the directory where private X application resource files are kept, often the home directory.

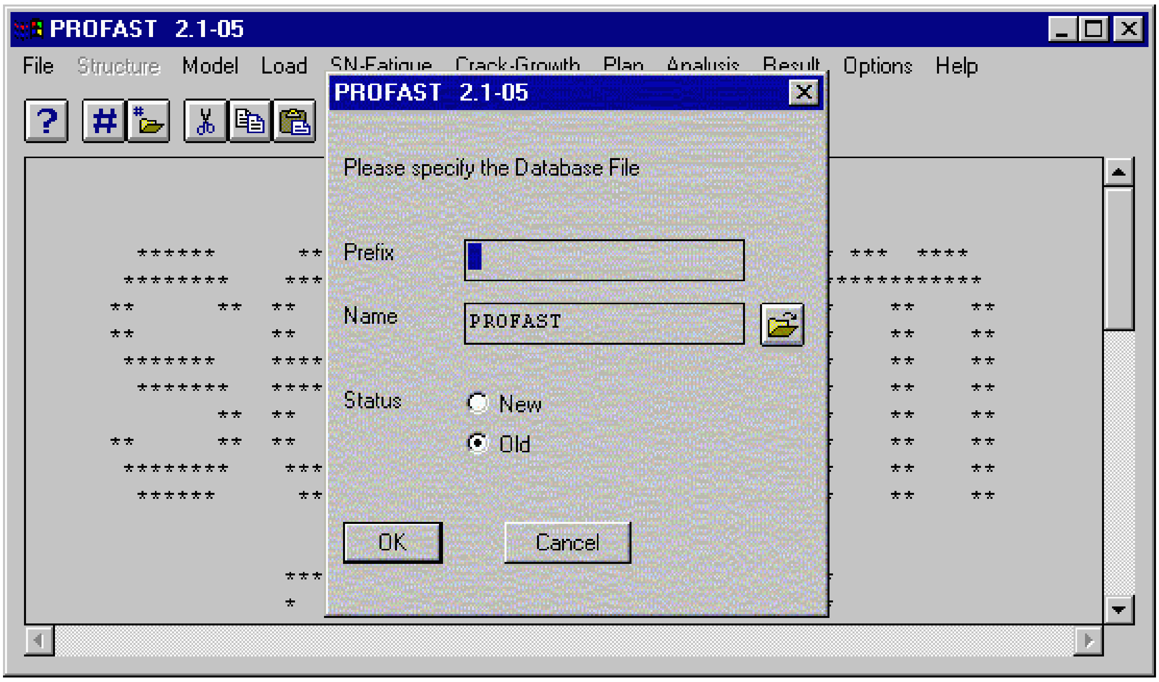


Figure 4.1 The program start-up dialog box

On VAX/VMS, this file must contain the following line:

```
faceitClass*fontList: fixed
```

If running on a VAX, the command to be used to start Profast in graphics mode is either

```
$RUN SESAM:PROFAST_MOTIF.EXE
```

or

```
$PROFAST_MOTIF :== SESAM:PROFAST_MOTIF.EXE
$PROFAST_MOTIF
```

If running on a Unix system, the program name is simply typed:

```
prompt> profast
```

Profast responds by opening the main window, and overlaying it with a dialog box requesting the database file prefix, name and status, provided that none of these were specified as command line arguments (see Section 4.1.1).

Note that the default status is **Old**. Type in the file prefix and name., and select the proper status., the press the **OK** button (or type <Return>). Pressing the **Cancel** button will abort the session.

If the file specification is somehow in error, Profast will give an error message and keep the start-up dialog box open for a new file specification.

If the file specification is correct, Profast will open the database file (with extension “.MOD”) and a journal file with the same prefix and name (but with extension “.JNL”). Profast can now be operated as described in Section 4.5 Using the Graphics Mode User Interface.

To exit the program, choose the Exit option under the File menu. Profast will then close all open files and terminate execution.

4.1.3 Starting Profast in Line Mode

A line mode session will not give access to the interactive graphics mode capabilities. The program runs in the terminal (window), and commands are typed on the input line.

To start Profast in line mode, specify /INTERFACE=LINE as a command line argument (see Section 4.1.1).

After a short while, (provided that the /NOHEADER was not specified on the command line), a heading, similar to the one below, is echoed on the screen.

```
      ******      ******       ******       ******      ** ***  ****
     ********    ********     ********     ********     *************
    **      **  **      **   **      **   **      **    **    **    **
    **          **      **   **                   **    **    **    **
     *******    **********    *******      *********    **    **    **
      *******   *********      *******    **********    **    **    **
            **  **                   **   **      **    **    **    **
    **      **  **      **   **      **   **      **    **    **    **
     ********    ********     ********     *********    **    **    **
      ******      ******       ******       ****** **   **    **    **


                 *****************************************
                 *                                       *
                 *            P R O F A S T              *
                 *                                       *
                 *      Probabilistic Fatigue Analysis   *
                 *                                       *
                 *****************************************

                    Marketing and Support by DNV Sesam

Program id   : M2.1-01                Computer         : DEC 3000 Model 400
Release date : 23-OCT-1996            Impl. update     :
Access time  : 23-OCT-1996 15:06:55   Operating system : VMS V6.1
User id      : OLES                   CPU id           : 0858461026
                                      Installation     : DNVS GRID

Copyright DET NORSKE VERITAS SESAM AS, P.O.Box 300, N-1322 Hovik, Norway
```

Profast then invites the user to enter the model file name (more information in section 4.1.2) through the following prompt;

```
Database file prefix ? / /
Database file name? /PROFAST/
```

No extension should be given since this file has a predetermined extension (For VAX/VMS installations this is .MOD). The file name PROFAST (i.e. PROFAST.MOD) is offered as a default.

```
Database File Status? /OLD/ NEW
```

If the Profast database file already exists or if it a database created by Framework, the default OLD should be given,. If the database is to be created, the answer is NEW. See also Section 4.1.6.

Note that if at least one of /PREFIX, /NAME or /STATUS is specified as a command line argument, the prompts for these values will be ignored, and the value(s) that are not specified will be given defaults.

This start-up has opened a new database file, called PROFAST.MOD and a new journal file, called PROFAST.JNL (this session is running on a VAX). If the file specification is somehow incorrect, Profast will reissue the prompt for the database file prefix.

Typing a double dot (..) during the start-up phase will abort the program.

The facilities that are available in line mode are described in Section 4.4.

To exit the program, type the EXIT command. This will close all files and exit the program.

4.1.4 Starting Profast in a Batch Run

Using command line arguments (see Section 4.1.1) is the simplest way to execute Profast in batch. if Profast is the command that executes the program, the command to run test_in.jnl in batch could be:

```
Profast /NAME=TEST/STAT=NEW/INT=LINE/C-F=test_in.jnl/FORCED-EXIT
```

Note that it is necessary to use the line mode interface, and that the forced exit tells the program to exit when the command input file has been read. This command assumes that it is started at the directory where the database file and command input file will be (is) located.

This command can be enclosed in a batch command file (script). During a run, Profast reads commands from standard input (SYS$INPUT in the VMS environment), so the commands can be typed into the batch file after the program start-up.

On a VAX, the batch command file could look like this:

```
$ SET DEFAULT mydisk:[mydir]
$ Profast /NAME=TEST/STAT=NEW/INT=LINE/C-F=test_in.jnl/FORCED-EXIT
$ EXIT
```

Alternatively, the commands could be specified directly in the batch command file:

```
$ SET DEFAULT mydisk:[mydir]
$ DEFINE/USER SYS$INPUT Profast.INP
$ RUN SESAM:Profast
   ' ' Profast NEW
   @TEST_IN.JNL
   EXIT
$ EXIT
```

Note that FOR005 cannot be used instead of SYS$INPUT. Profast does not read from FORTRAN unit 5.

On a UNIX system the user could create a similar batch input file, e.g. Profast.inp, and then issue one of the commands below in order to execute Profast as a background process

```
prompt> Profast < Profast.INP > Profast.LOG &
```

or:

```
prompt> Profast /NAM=TEST/STA=N/INT=L/C-F=test_in.jnl/F-EX > Profast.LOG &
```

The header and messages given by Profast will appear on the log file.

4.1.5 Files and Data Safety

Table 4.2 Overview of Profast file handling

File type	Extension	Profast		Format
		Reads from	Writes to	
DATABASE	.MOD	YES	YES	Binary
Results Interface	.SIN	YES	NO	Binary
JOURNAL	.JNL	NO	YES	ASCII
COMMAND INPUT	.JNL	YES	NO	ASCII
PRINT	.LIS	NO	YES	ASCII
PLOT	varies	NO	YES	Binary/ASCII

Profast makes use of the files shown in table above.

The **DATABASE** (also called MODEL file) is a direct access file that is used to keep the section geometry and results. It has the extension: ".MOD".

The **RESULTS INTERFACE FILE** (also called SIN-file) file is a direct access file that keeps the results from the finite element analysis. This file is only read from, but must always be kept available in the same location after first accession using the FILE OPEN command. It has the extension: ".SIN".

The **JOURNAL** file is used to keep a log of most of the commands that are accepted during a Profast session. If an existing (OLD) database is opened, the journal will be appended to the corresponding old journal file if this exists. The journal file has the extension ".JNL".

The **COMMAND INPUT** file is used to read commands and data into Profast. The usage of command input files is described in Section 4.4.2. The default extension of a command input file is ".JNL", but this default is not used if another extension is specified.

The **PRINT** file is used to keep output from the PRINT command when the print destination is set to FILE. The extension of the print file is ".LIS". The print file name and settings is specified using the command: SET PRINT. It is possible to use more than one print file during the same Profast session, but only one can be open at a time.

The **PLOT** file is used to keep output from the PLOT command and from the DISPLAY command when the display destination is set to file. The plot file name and settings is specified using the command: SET PLOT. The extension of the plot file depends on the plot format used. If the SESAM neutral format is used, the extension is ".PLO". Several other formats are available, including Postscript with extension ".PS". It is possible to use more than one plot file during the same Profast session, but only one can be open at a time.

If the database file has been corrupted, the information may be reconstructed by use of the journal file. It is therefore recommended to take backup copies of the journal and database file at regular intervals.

4.1.6 Starting Profast from a Framework Database

When starting Profast from a Framework database, care must be taken so that it is easy to use the journal files from the two programs to reconstruct both analysis sequences.

The problem is, that both Profast and Framework use the same name for the database and journal file.

So, if Profast is started directly on the database that was closed by Framework, Profast will append its journal led commands to the existing journal file, produced by Framework. As the file starts with commands that are legal in Framework, but illegal in Profast, it becomes difficult to reconstruct the analysis sequence from the journal file.

There are two ways to ensure that it becomes easy to reconstruct the analysis sequence:

1 By copying the database created by Framework.

2 By renaming the journal file created by Framework.

In both cases, Profast will work on a database with a new name, and start journalling to a new file. Thus, there will exist one journal file with commands that can be used to recreate the Framework analysis sequence, and another that can be used to recreate the Profast analysis sequence.

In case a change is required in the Framework analysis, the Framework database can be modified (if case 1. was used) or reconstructed from the Framework journal file before the required modification is performed. The journal file produced by Profast can then be used with the modified Framework database to recreate the Profast analysis.

Please note that the SIN file used by Framework (and any FEM file that is also used) must be available for Profast also. Thus, if the Framework model file is copied or moved to another directory, the SIN (and possible FEM) file(s) may have to be copied/moved also.

4.2 Program Requirements

4.2.1 Execution Time

Most of Profast can be run interactive with no significant timing problems. However, the following situations may require so much computation time, that a batch run is advisable:

1 Calculating an inspection plan with several points

2 Calculating a crack growth analysis over the service life for a fatigue point with several inspections.

Because of an internal buffer limit, the database access performance may degrade considerably when a certain size of the database has been reached. It is not possible to predict exactly when this will happen.

4.2.2 Storage Space

The initial size of the database on ALPHA/VMS is ca. 400Kb when not using a Framework database.

A Framework database is initially expanded by ca. 250Kb on an ALPHA/VMS system.

The most significant contributor is the storage of SN and crack growth failure analysis results. The database containing the tutorial analysis takes up ca. 7.5Mb on an ALPHA/VMS system.

4.3 Program Limitations

The following limitations apply. See also the status list for current updates to this.

The names of fatigue points, inspections, SN curves, wave spreading functions, transfer functions and wave statistics are limited to 8 characters. The names of variables, events and results are limited to 12 characters. All names are case insensitive when matched with input text. The names of SN curves, wave spreading functions, transfer functions and wave statistics will be forced to upper case.

Descriptive texts are in most cases limited to 50 characters.

A maximum of 20 inspections can be created at the same fatigue point.

A maximum of 99 influence coefficients can be specified in one assignment.

Up to 36 wave directions and 201 frequencies can be used.

One scatter diagram can contain up to 25 different values of Hs, up to 25 different values of Tz and up to 7500 cells in all directions.

A maximum of 10 sets of transfer functions (stochastic linearisations for different values of (Hs,Tz)) can be specified for one fatigue point.

A maximum of 50 fit points can be specified for a deterministic Weibull stress range distribution fit.

The crack growth calibration is limited to 5 time points, up to three parameters can be adjusted, and no more than 99 iterations can be used.

Up to 200 data points can be specified in a data fit to a geometry function of a weld effect.

Each inspection plan can contain up to 100 fatigue points. A maximum of 50 prescribed time points can be specified.

There is a limit on the number of random variables that can be presented through the user interface (this limit does not apply to the number that can be stored in the database). If very many fatigue points and inspections are created, the number of variables created by Profast may exceed this limit. The effect is to prohibit use of some commands and generate some error messages when the commands are used. The commands, that in particular may create problems, include

```
DEFINE PARAMETER-STUDY
ASSIGN SENSITIVITY
PRINT VARIABLE
RUN PROBABILITY-ANALYSIS
RUN DISTRIBUTION-ANALYSIS
RUN DETERMINISTIC-ANALYSIS.
```

4.4 Using the Line Mode User Interface

The line mode environment in Profast is very powerful. It has many features and provides a great flexibility to the user. This section describes the facilities one by one. Even when running graphics mode, the line mode environment is available through the command input line.

There are two modes of operation inside the line mode environment, called “command mode” and “programming mode”.

Command mode is the commonly used mode, it is used to give commands to Profast. A new input line always starts in command mode. To switch to/from programming mode inside an input line, type the dollar sign: $.

Programming mode is used basically to calculate numerical values. These values can then be used in a command if desired, or they can be viewed as results.

When moving through the commands, Profast will present a prompt, possibly followed by a default in / /. The main command level is signified by the prompt: #. No default is presented here. The main commands are ASSIGN, CREATE etc. These are described in chapter 5. When moving inside a command the prompt will change and a default may be presented.

Different items on the command line are separated by blank spaces, except if it is text that is protected inside quotes. In special cases, the blank space may be left out. Such cases are documented in the sections below.

Profast does not require line breaks anywhere. Thus several commands can be typed into the same command input line.

In the following, input typed by the user is shown in bold face while prompts given by Profast are shown as ordinary text.

4.4.1 How to Get Help

Context sensitive help is available in command mode at any time using any of these methods:

Table 4.3 How to get help in line mode

Type: ?	to get a brief description of what Profast is expecting right now.

Table 4.3 How to get help in line mode

Type: <text>?	during a selection between alternatives to see all the alternatives that match <text>. <text> may contain wildcards or be an abbreviation.
Type: ??	to get a more descriptive help text, showing how to proceed.

There is also a HELP menu under the main menu, giving on-line access to the items that are described here.

4.4.2 Command Input Files

Line mode commands may be read from a file as well as typed directly into Profast. Such a file may contain any syntax that is allowed in line mode, including reading another command input file.

The commands used to manipulate command input files are summarised below.

Table 4.4 Manipulation of command input files

@file name	Read the named file from the top. Reading will stop is an error if found, or at the end of the file, or if a line with only an @ is found. There may be one or more blank spaces between @ and the file name.
@file name <n>	Read <n> lines of the named file from the top. Reading will stop if an error is found, or if a line with only an @ is found. There may be one or more blank spaces between @ and the file name.
@	Continue reading the presently open file. Reading will stop if an error is found, or at the end of the file, or if a line with only an @ is found.
@ <n>	Continue reading the presently open file. Reading will stop if an error is found, or if a line with only an @ is found.
@..	Close the last opened command input file. There cannot be any blank space between @ and the dots.
@?	Show the name and status of the currently open command input file(s).

To read in a command input file, type an @ followed by the file name. To read parts of the file, specify the number of lines to read after the file name. If the file name does not have a suffix (i.e. a dot and the following part), Profast adds ".JNL" to the name.

Profast may have more than one command input file open at one time (i.e. you may reference a command input file from within another command input file). It will always read each file sequential, finishing the last opened file first. To get a list of the currently open files, type: @?

The last opened command input file may be closed explicitly by typing the @ followed by two dots: @..

When a command input file is being read, the lines read are echoed on the screen and logged on the journal file. Programming expressions are logged as comments and the resulting values are logged as part of the command. The @ command itself is not logged on the journal file.

If an error is found in a command input file, Profast stops reading the file and skips the remaining part of the line where the error was found.

Profast will also stop reading of a command input file if it finds a line containing only an @

4.4.3 Accessing Default Values

Profast will in many cases supply a default value when input is requested. The default will be presented in / / . An example:

```
DEFINE TOLERANCE COORDINATE
Coordinate tolerance? /2.019901e-03/
```

The default may be accepted using one of the following methods:

Table 4.5 Input of default values

<Return>	(i.e. an empty input line) to accept the current default.
: (colon)	to accept the current default. The colon must be preceded by a blank if it is not the first item on the command line.However, several colons may follow each other without intervening spaces.
; (semicolon)	to keep accepting defaults as long as they are presented, or until the command is complete. The semicolon must be preceded by a blank space if it is not the first item on the command line. However, several semicolons may follow each other without intervening spaces.

Please note that an empty line in a command input file will not be interpreted as a default. The colon and semicolon may be written into a command input file.

A colon or semicolon is never logged on the journal file. Instead, the substituted default value(s) is logged.

4.4.4 Abbreviation and Wildcards

Profast offers two methods to short-cut selection of elements in a list: Abbreviation and the use of wildcards.

Abbreviation allows abbreviation of alternatives up to hyphens, as long as the abbreviation is unique. Thus, CALIBRATION-CRACK-GROWTH may be abbreviated to any of: CAL, C-C-G, CAL-C as long as the abbreviation is unique among the alternatives presented.

Wildcards consist of the following two characters:

Table 4.6 Wildcard characters

*	substitutes for any number of characters (including no characters).
&	substitutes for any one character. It must match exactly one character.

As an example, *y&&& matches xabycc1 and xy111 but not xaby11.

Abbreviation and wildcards may not be mixed in the same matching expression.

4.4.5 Input of a Text or Name or Numerical Value

Numerical values can be input in free format in Profast. Floating point numbers as: 1000 1..54 1e-44 .1e5 are all accepted.

Whole numbers can be specified as floating point numbers. Examples of whole numbers: 1000 1. .1e4

Names may contain any alphanumeric character as well as the underscore (_) and the hyphen (-). A name may be a whole number (i.e. this is a legal syntax), or may begin with an alphanumeric character, however it is strongly recommended to start all names with an alphanumerical character or an underscore. The maximal length of a name is documented with the command where the named object is created.

Text must be encapsulated in single quotes if it contains blank space(s) and/or special characters:

```
'This is a text containing 10 spaces and a single @'
```

4.4.6 Selecting a Single Alternative from a List

In many cases, Profast will require a selection of a single alternative from a list. An example is right at the start, at the main prompt: #, where the main commands are presented for selection. The selection need not be a selection between commands, it could also be a selection between named objects or between numerical values.

In selection of a single value, abbreviation is allowed, but wildcards cannot be used. An exact match is always preferred. Thus it is possible to select an item that is an abbreviation of another item in the list by typing the item exactly.

A single question mark: ? will show all items in the list. Prefixing the question mark with a a text: <text>? will show all items in the list matching <text>.

The input text may be typed in upper or lower case as desired, Profast disregards the case of the text when it does the comparison.

The input text used to make the selection is not logged on the journal file. Instead, the selected value is logged as it is presented in the list.

4.4.7 Selecting Several Alternatives from a List

In some cases, a list of items is presented, from which one or more items can be selected. An example is the DISPLAY SN-CURVE command, where a number of names may be selected for display.

In this selection, both wildcards and abbreviation may be used (but not inside the same text).

The syntax for the selection allows for more flexibility than in the single selection case, because it may be of interest to keep modifying the selection for some time before accepting it. The selection process consists of one or more selection operations, each of which follow the syntax described below. If more than one operation is required to complete the selection, the selection must be enclosed in parentheses: ( )

The syntax for a single selection operation is:

Table 4.7 Selection of several alternatives from a list

INCLUDE <text>	Include the item(s) matching <text> in the selection. Set the default status to INCLUDE. Any items specified after this will be included in the selection until the status is changed.
ONLY <text>	Set the current selection to the item(s) matching <text> Set the default status to INCLUDE. Any items specified after this will be included in the selection until the status is changed.
EXCLUDE <text>	Exclude the item(s) matching <text> from the selection. Set the default status to EXCLUDE. Any items specified after this will be excluded from the selection until the status is changed.
<text>	Include or exclude the items matching <text>, depending on the default status. The initial default status is INCLUDE.
GROUP <from> <to> <step>	In the case of a selection of numerical values, or of a selection between names (which can be integer values), the <text> can be substituted with this interval expression which expands to the values: <from>, <from> + <step>, <from> + 2*<step>, ...up to but not exceeding <to>.

When a default selection is being presented, or if the left parentheses has been typed as input, Profast presents the right parenthesis as default: /)/.

A single question mark: ? will show all items in the list, listing the currently selected items in parenthesis. Prefixing the question mark with a text: <text>? will show all items in the list matching <text>.

Examples:

```
DISPLAY SN-CURVE *
```

will display all SN-curves currently stored in the database.

```
DISPLAY SN-CURVE ( * EXCLUDE B* )
```

will display all SN-curves except those with names starting with B.

4.4.8 Entering a Vector or Matrix of Values

The syntax for entering a vector or matrix of values is an extension of the syntax for selecting values from a list. In this case there is no fixed list to select from. Instead the items are inserted and manipulated as the vector/matrix is entered.

The term vector is used for the case where the input is one dimensional. The term matrix is used for the case where the input is multidimensional. Like a vector is built up from single items, a matrix is built from rows. There cannot be an unequal number of items in two different columns of a matrix.

The input of a vector/matrix is consists of one or more operations. If more than one operation is required (as it most likely will be), they must be enclosed in parentheses.

The syntax of one operation is (<row> refers to a single value in a vector or to a row in a matrix):

Table 4.8 Entering a vector of matrix values

INCLUDE <row>	Include the specified <row> as the last row. Set the default status to INCLUDE. Until the status is changed, rows that are entered will be added at the end.
EXCLUDE <row>	Exclude the specified <row>. Set the default status to EXCLUDE. The next row(s) that are entered will also be excluded until the default status is changed. Wildcards may be used to specify <row>. All matching rows will be excluded.
ONLY <row>	Include only <row> in the matrix, clearing any previous contents first. Set the default status to INCLUDE. Until the status is changed, rows that are entered will be added at the end.
INSERT-BEFORE <row1> <row2>	Insert <row2> before <row1>. Set the default status to INSERT-BEFORE. Until the status is changed, rows will be keep being inserted before <row1> (immediately after the last row entered). Wildcards may be used to specify <row1>, provided that one row is matched uniquely.
OVERWRITE <row1> <row2>	Overwrite <row1> with <row2>. Set the default status to OVERWRITE. The next row(s) that are entered will continue overwriting until the default status is changed, scrolling down as they do so. When the last row has been overwritten, the default status is changed to INCLUDE. Wildcards may be used to specify <row1>, provided that one row is matched uniquely.
LIST	List the contents of the matrix.
<row>	Insert, Exclude or overwrite, using <row>, depending on the default status. The initial default status is INCLUDE.

When a default vector/matrix is being presented, or if the left parenthesis has been typed as input, Profast presents the right parenthesis as default: /)/.

A single question mark will show the possible alternatives in the matrix.

Use LIST to see the rows in the matrix.

4.4.9 Setting and Clearing Loops in Command

When a command is completed, Profast will by default go back to the main prompt: #. If a command is to be repeated many time in slightly different versions, it can be desirable to not go back to the main prompt, but rather to some intermediate level. This is accomplished by typing in the text: LOOP at the point where the command is to be repeated. The loop is removed by typing END at the loop point, or by aborting the command using the double dot (..).

Example:

```
ASSIGN UNCERTAINTY VALUE
LOOP
  C3501-lnC  MEDIUM
  C3501-m    HIGH
```

```
  C3501-SC*  LOW
END
```

4.4.10 Inserting a Command Into Another Command

It is possible to insert a command at any point while in command mode (not in programming mode). This is done by simply typing the main prompt: # followed by the inserted command.

Profast will finish the new command, and then return to the point in the previous command, where the new command was inserted.

This is useful e.g. for catching up on settings or definitions that was forgotten while inside a PRINT or DISPLAY command, or for printing out objects to see what they contain. The following examples illustrate this:

```
DISPLAY SN_CURVE # SET GRAPH X LIMITS FREE
        ONLY DNV*
```

The same command cannot be entered recursive, e.g. it is not allowed to insert an DISPLAY SN-CURVE command inside another DISPLAY SN-CURVE command.

Commands can be nested this way to as many levels as desired. However, to nest with more than one level may be confusing and is not recommended. The current status may be seen by typing: -?.

4.4.11 Aborting all or Parts of a Command

To abort a command, type two dots after each other: .. . Please note that all entries on the command line up to the double dot will be processed before the command is aborted.

The double dot clears all loops and previous input in the command and then presents the main prompt: #.

A double dot is only logged if a part of the current command has already been written to the journal file.

To abort parts of a command, going back to the last LOOP or to the point of a left parenthesis in a multiple selection or a vector or a matrix, type: <<<.

CtrlC may also be used to abort a command (hold the Control key while typing C). Usage of CtrlC will throw away all of the input of the command line as well as abort the command. Unlike the double dot, the input before the CtrlC is not processed. CtrlC may also be used to abort a running analysis.

4.4.12 Access to the Operating System

It is possible to issue a command to the operating system at any point in a Profast command (not from programming mode). This is done by typing an exclamation mark: ! followed by the operating system command. Everything on the input line after the exclamation mark is sent to the operating system.

This example, taking from a run on a VAX computer, will list all SIN-files on current directory.

```
!DIR *.SIN
```

This command will spawn a sub process on a VMS system. It must be terminated using the command: LOGOUT.

```
!spawn
```

This command will spawn a sub process on a Unix system. It must be terminated using the command: exit.

```
!sh
```

This facility is very useful for obtaining directory listings, editing files (e.g. input files), spawning into the operating system to do more complicated tasks, etc.

This facility is also available from the command input line in graphics mode, but, when used here the output from the operating system will appear in the terminal window from which Profast was started.

4.4.13 Appending Input Lines

After receiving an input line, Profast will process the input, unless told otherwise. The way to suspend processing of an input line is to type a backslash: \ as the last character in the line. Profast will then issue the append prompt: >>.

4.4.14 Viewing the Current Status of a Command

Some commands are long, and it may be difficult to keep track of what has actually been given as input. In other cases where commands have been inserted, it is good to be able to see what the current command(s) actually look like to Profast. For this reason, the command: -? has been introduced.

4.4.15 Comments

A comment may be typed anywhere in a command while in command mode (not in programming mode). Comments are prefixed by the percent sign: %. Everything from the percent sign to the end of the line is treated as a comment. A comment need not be the first item on a line.

Examples:

```
DEFINE SERVICE-LIFE 0 25% In years
% This is a comment.
```

4.5 Using the Graphics Mode User Interface

The Profast graphics environment offers a main window with the following parts (from top to bottom):

- Title bar. This is the name of the program that is being run.
- Main menu. This menu gives access to all the commands of Profast.
- Short-cut buttons. The first three toggles command input mode on and off, reads a command input file and closes a command input file. This last button is only active when a command input file is open. The last three buttons will cut, copy and past texts to and from the text input areas in Profast.
- Message area. This is used to show messages to the user, plus commands that have been typed into the command input line, as well as those that have been read form command input files.

- Command input line This line contains the prompt for line mode input (showing the default when this is available), followed by a field which is used to type line mode commands. All facilities that are described in section are available through this line.

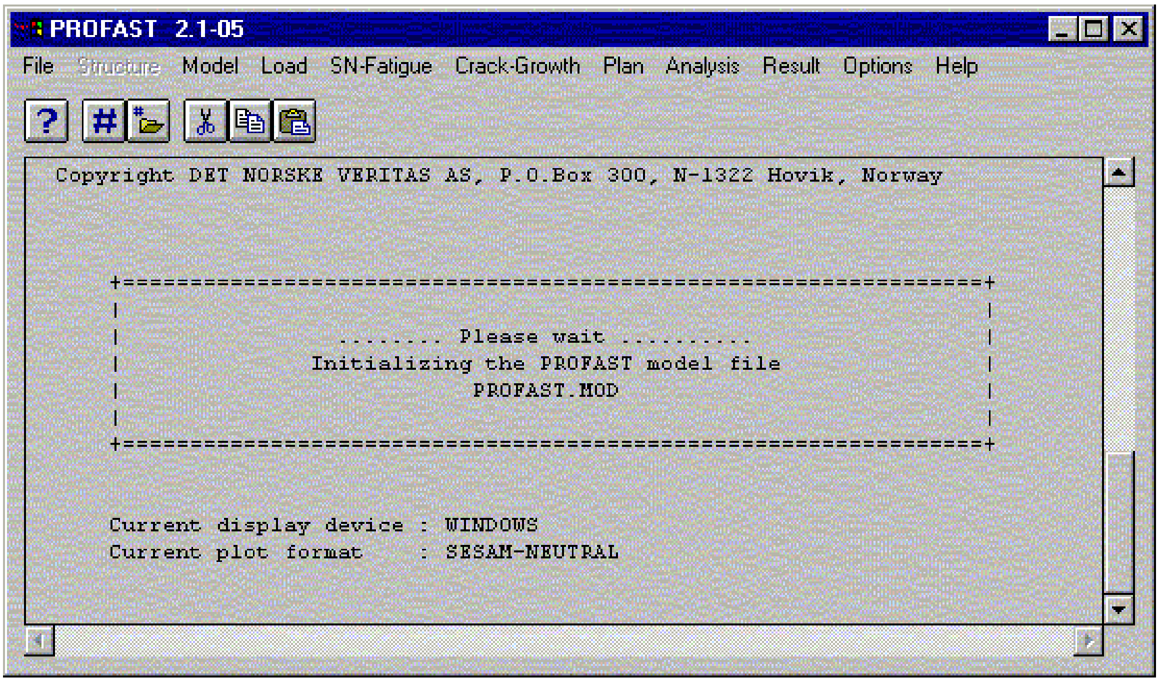


Figure 4.2 The main dialog window at start-up

In addition to the parts seen in Figure 4.2, the graphics area and command line area may be visible, as shown below:

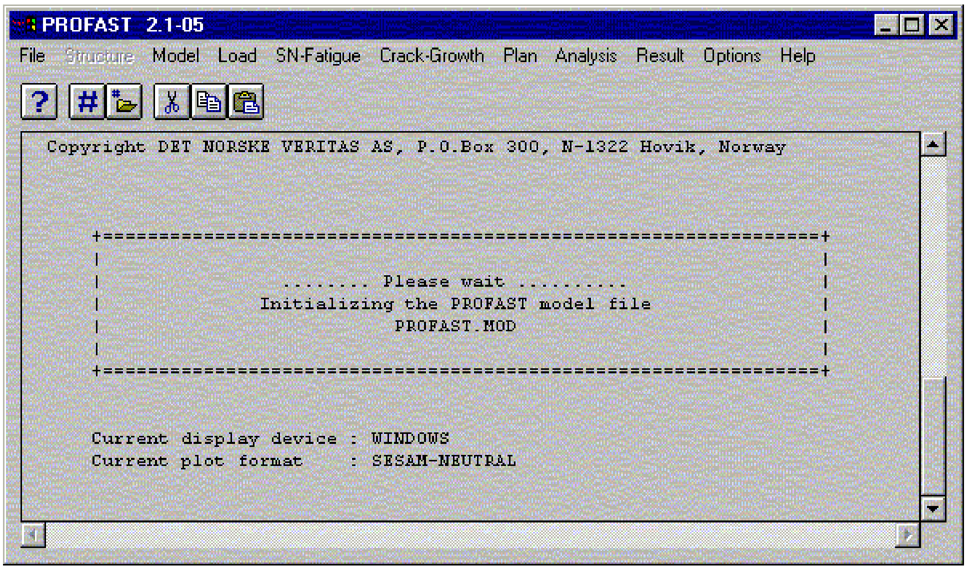


Figure 4.3 The main window with graphics area and line mode command input areas

These areas are described in more detail in the following:

- The graphics area is displayed the first time the need for displaying a drawing arises. When this happens, the main window will be resized to fill a good part of the screen. This area cannot be removed once opened (except by exit of the program and starting it again).

- The command line and prompt at the bottom, as well as the command list at the right and the six short-cut buttons are used to give line mode commands to Profast. A command can be entered by clicking in the command list or by typing text in the command line, followed by <Enter>. The short-cut buttons all have explanatory texts attached, visible when the mouse pointer is paused over the button. Two extra buttons appear when a command input file is open.

If the main window is iconised, all the open dialog boxes disappear into the icon. They pop up again when the main window is popped up. In addition to this, the graphics environment consists of:

- Pulldown menus. These are pulled down from the items in the main menu. They are activated by clicking on an item in the main menu with the left mouse button, or by holding the left mouse button down on an item in the main menu. Similarly, some of the items in a pulldown menu may have a sub menu sliding side-wards from the parent menu. To select an item in a pulldown menu, click on it or drag the mouse pointer to the item and release the button.

- Dialog boxes. Much of the user interaction will happen through dialog boxes. Those items in the pull-down menus that have three dots following the item label, all open a dialog box when selected. The dialog box is described more fully in Section 4.5.3.

- Print window. After the first Print command has been issued, a print window will pop up. This window can be scrolled and contains all the output from the Print command, that is directed to the screen. The window has a limited buffer, so if a single print command generates excessive amounts of print, some of it may disappear out of the top of the window. The print window may be iconised separately from the main window. It is possible to print inside an iconised print window. It does however not pop up automatically from an iconised state when something is printed.

4.5.1 How to Get Help

There is a Help menu under the main menu, which contains much useful on-line information.

Context sensitive help is available through a Help button (the F1 button on some computers). When an entry in a dialog box (e.g. a text input field or a list that can be scrolled) is active, pressing the Help button will often display a context sensitive help text in a separate window.

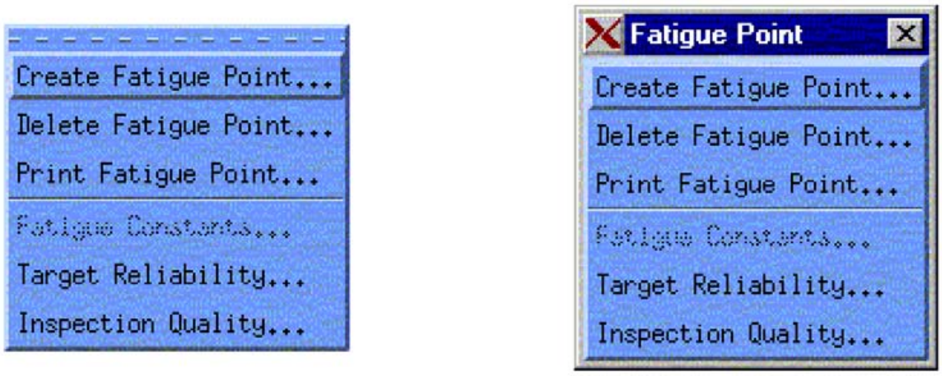


Figure 4.4 Tear-off pulldown menu before and after it is torn off

4.5.2 Tear-Off Menus

When using Motif version 1.2 or greater, the pulldown menus can be torn off and displayed in separate windows. This is very useful for accessing commonly used dialog boxes. The menu is torn off by clicking on the stipulated line at the top of the menu (if no such line is visible, the menu cannot be torn off). To close the menu, select the “Close” entry in the menu at the upper left corner of the window frame.

4.5.3 Dialog Boxes and Their Contents

A dialog box is used to pass information from the user to Profast. Most dialog boxes also present the current defaults, and thus may be used to pass information from Profast to the user.

The typical entries in a dialog box are: **Input fields**, **Menus** and **Pushbuttons**.

An **Input field** can contain a text, a name, a whole number or a numerical value. The Set Plot dialog box contains two input fields: the file prefix and the file name description. To type into the field, click in it first using the left mouse button. In some input fields, the text can be longer than the width of the field as shown in the dialog box. The text will then scroll if typed beyond the width of the input field.

Menus come in four different types: **Togglebuttons**, **Radio boxes**, **Option menus** and **Scrollable lists**. Selecting in a menu may cause considerable changes in the layout of the dialog box. This will depend on the dialog box in use.

A **Togglebutton** is a button that has two states: On and Off. One examples is given in the Set Plot box, where the Colour button is Off. Click on the button or on the corresponding label to switch the status of the button.

A **Radio box** is a collection of togglebuttons, where only one of the buttons can be active at any one time. All buttons are visible on the screen simultaneously. An example is the Members buttons the Select Member box. Click on a button or on the corresponding label to select that button.

An **Option menu** is similar to a radio box, in that it presents a number of alternatives, of which only one is active at any one time. It is however operated differently. Click on the menu (not the corresponding label) to bring up the list of alternatives. Then click on an alternative to select it. Alternatively, click on the menu and hold the button down, then move the mouse pointer through the menu to the selected value, and then release the mouse button. Page size menu in the Set Plot box is an example of an option menu.

A **Scrollable list** is a list of alternatives, that is presented in a scrollable box. Such a menu is used in order to preserve space, or because the items in the list cannot be predicted before the menu is used. Use the scrollbar to manoeuvre through the list, and select a value by clicking on it. The Format list in the Set Plot box is an example of a scrollable list. See also Section 4.5.5

A **Pushbutton** is a button, that causes an action to happen when it is clicked on.

OK, Apply and Cancel buttons are represented in the Set Plot box shown above. All dialog boxes have a standard set of buttons at the bottom of the box. These buttons are described later in this section.

If the label of a pushbutton is followed by three dots, the button will open a new dialog box. The Assign dialog boxes often contain pushbuttons that provide a short-cut to boxes placed under the Select main command.

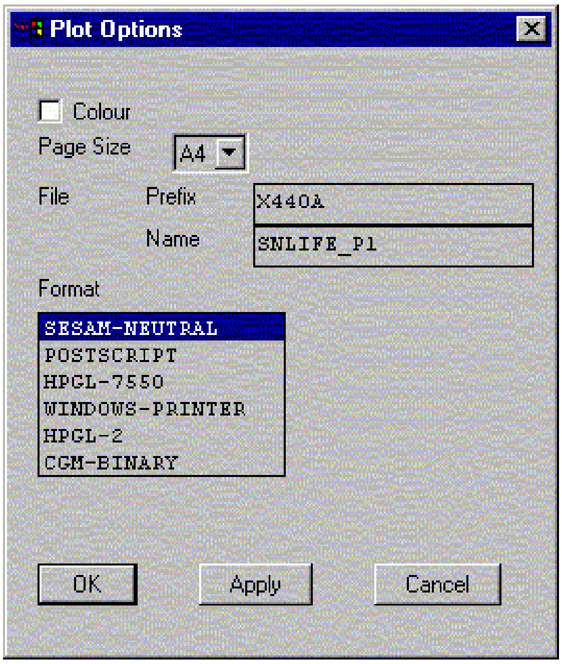


Figure 4.5 The Set Plot dialog box

In addition to these items, there are a few more complex input items, that are described in the following sections.

4.5.4 The Standard Buttons in a Dialog Box

A dialog box will contain one or more of these standard buttons, placed at the bottom of the box:

OK	Accept the contents of the box and close the box. The box will not be closed if there is an error in the information inside the box.
Apply	Accept the contents of the box. The box is not closed.
Cancel	Close the box without accepting the contents.
Close	Close the box without accepting the contents.
Update	Update the contents of the box to correctly represent information changed elsewhere.
Help	Provide context sensitive help

Most dialog boxes have a default pushbutton, that is activated by typing <Return> when the dialog box is active. This pushbutton is usually the OK or the Apply button. The default button will be highlighted or framed.

4.5.5 Selecting Several Alternatives from a List

In e.g. the PRINT SN-CURVE command, a scrollable list of all curves is presented. Any number of variables can be selected from this list for print. Selected values are marked by highlighting.

The basic way to select values is to click on a value, and then drag the mouse through the list. All values that the mouse pointer is dragged through are selected, and any previously selected value becomes un-selected. To modify an existing selection, hold the Control key down while clicking in the list or dragging the mouse pointer through the list. All items that are clicked on while the Control key is held will reverse their selection status.

4.5.6 Entering a Prefixed List

The prefixed list is used to enter a number of values, that is unknown until the time the box is used, where each value has a prefix (or prompt). It is used to input distribution parameters, function arguments and starting point values.

In line mode, the list is simply traversed sequential from top to bottom. In graphics mode, the accompanying input field (located just below the box) is used to input and change values. The procedure used to change or input a value is:

- Select the corresponding row in the box. Double-click on the row if desired to transfer the current value to the input field. If no row is selected, the first row is implicitly used.
- Type the correct value in the input field.
- Hit <Return> in the input field to transfer the value to the box. The next row in the box will then be selected and the input field will be cleared.

Thus it is possible to input values sequential into the box by clicking on the input field and then typing the values one by one, with each value followed by a <Return>.

4.5.7 Entering a Vector or Matrix of Values

In many cases a vector or matrix of values must be input. An Example is entering a scatter diagram by the CREATE WAVE-STATISTICS command.

The graphics mode input of this is quite flexible. The values are presented in columns in a scrollable box. Under the box is one input field for each column in the matrix (one field if it is a vector). Under the input field(s) are two rows of buttons, that are used to manipulate the contents of the box.

Type values into the input fields, and hit <Return> in the last (bottom) field. The values are then inserted at the bottom, or before the selected row, or will overwrite the selected row, depending on the default status. The initial status is Include, which inserts values at the bottom. The input fields are cleared after the insertion is complete. Instead of pressing <Return>, a button may be pressed. The effect of this is:

Include	Include the values in the input field(s) at the bottom, then clear the input fields. Sets the default status to Include.
Exclude	Exclude all selected rows from the matrix/vector. Sets the default status to Exclude.

Overwrite	Overwrite the selected row with the contents of the input fields. Only one row can be selected in the scrollable box. The next row (if any) will then be selected, and the default status will be set to Overwrite. The input fields will be cleared.
Insert before	Insert the contents of the input fields before the selected row. Only one row can be selected in the scrollable box. The default status will be set to “Insert before”. The input fields will be cleared.
Clear	Clear the contents of the matrix. NOTE: There is no way to get the cleared contents back, other than perhaps cancelling the dialog box and opening it again.
Help	Pressing this is equivalent to pressing the help button while the scrollable box has the input focus. It provide on-line access to a description of how to use the matrix/vector.

4.5.8 Journalling from Graphics Mode

All commands that are accepted from graphics mode are logged on the journal file. The commands are logged in a format that can be read into the corresponding line mode command.

There is one case, that deserves attention:

Some dialog boxes contain many line mode commands. An example is the Set Plot dialog box (Figure 4.5). Since all the visible contents of a dialog box are selected when the OK or Apply button is pressed, even if only parts of the box has been changed, all possible commands in the box will be logged.

Pressing the OK or Apply button in this box will generate the following log:

```
SET PLOT COLOUR OFF
SET PLOT FILE ' ' Profast
SET PLOT FORMAT SESAM-NEUTRAL
SET PLOT PAGE-SIZE A4
```

5 COMMAND DESCRIPTION

This chapter describes all the commands available in Profast.

As described in Chapter 4, Profast has two user interfaces: A graphical user interface (also called graphics mode) and a text based command interface (also called line mode).

The first section of this chapter lists the correspondence between the pulldown menus available in the graphical user interface and the line mode commands.

The line mode input is journalled, also when the graphical user interface is used. The line mode input is therefore described in full in this chapter. The second section lists the line mode commands alphabetically.

The hierarchical structure of the line-mode commands and numerical data is documented in this chapter by use of tables. How to interpret these tables is explained below. Examples are used to illustrate how the command structure may diverge into multiple choices and converge to a single choice.

In the example below command A is followed by either of the commands B and C. Thereafter command D is given. Legal alternatives are, therefore, A B D and A C D.

<table>
<tr><td rowspan="2">A</td><td>B</td><td rowspan="2">D</td></tr>
<tr><td>C</td></tr>
</table>

In the example below command A is followed by three selections of either of commands B and C as indicated by *3. For example: A B B B, or: A B B C, or A C B C, etc.

<table>
<tr><td rowspan="2">A</td><td>B</td><td rowspan="2">*3</td></tr>
<tr><td>C</td></tr>
</table>

In the example below the three dots in the left-most column indicate that the command sequence is a continuation of a preceding command sequence. The single asterisk indicate that B and C may be given any number of times. Conclude this sequence by the command END. The three dots in the right-most column indicate that the command sequence is to be continued by another command sequence.

<table>
<tr><td rowspan="3">...</td><td rowspan="3">A</td><td>B</td><td rowspan="2">*</td><td rowspan="3">...</td></tr>
<tr><td>C</td></tr>
<tr><td colspan="2">END</td></tr>
</table>

In the example below command A is followed by any number of repetitions of either of the sequences B D and C D. Note that a pair of braces ({ }) is used here merely to define a sequence that may be repeated. The braces are not commands themselves.

<table>
<tr><td rowspan="2">A</td><td rowspan="2">{</td><td>B</td><td rowspan="2">D</td><td rowspan="2">}*</td></tr>
<tr><td>C</td></tr>
</table>

The characters A, B, C and D in the examples above represent parameters being line-mode COMMANDS (written in upper case) and numbers (written in lower case). All numbers may be entered as real or integer values. Brackets ([ ]) are used to enclose optional parameters.

A parameter followed by a '+' signifies a selection of one or more numerical values, names or texts from a list of items.

A parameter followed by a '*' signifies one or more alphanumeric or numerical values of the same type. These values are entered as a prefixed list.

Note: Line mode commands are in this chapter presented in upper case including hyphens. In graphics mode the commands appear in mixed case and without hyphens.

Note: Graphics mode commands that are irrelevant at a given time are masked out (shown grey in graphics mode).

Use of Profast in graphics mode is described in Section 4.5. Tutorial examples of line mode command input are given in Appendix A.

The HELP command is not described here. It is intended purely to serve as on-line help. Usage of the HELP command is not logged. When in doubt how to do things try the HELP command.

5.1 Graphical User Interface Menus

The pulldown menus of the graphical user interface are listed here from left to right and top to bottom, together with the line mode commands to which they correspond. The line mode commands can be found alphabetically in the next section.

Please note that some line mode commands are available through more than one pulldown menu. This is purely for convenience, and does not affect the journalling of these actions. Some dialog boxes are also available through short-cut buttons inside other dialog boxes.

5.1.1 The File Menu

This pulldown menu contains file manipulation commands and the command used to exit Profast.

Open	FILE OPEN
Plot	PLOT
Exit	EXIT

5.1.2 The Structure Menu

This menu contains commands used to view the structure imported from a Framework database and/or from a SESAM interface file. It will only be available when such a structure has been imported.

Display Superelement	DISPLAY SUPERELEMENT
Display Member	DISPLAY MEMBER
Display Joint	DISPLAY JOINT
Display Label	DISPLAY LABEL
Display Presentation	DISPLAY PRESENTATION
Display View	DISPLAY VIEW

5.1.3 The Model Menu

This menu contains commands used to model the critical points to be analysed, strength coefficients and inspections, in addition to uncertainties and general stochastic modelling.

Service Life		DEFINE SERVICE-LIFE
Fatigue Point -		
	Create Fatigue Point	CREATE FATIGUE-POINT
	Delete Fatigue Point	DELETE FATIGUE-POINT
	Print Fatigue Point	PRINT FATIGUE-POINT
	Fatigue Constants	DEFINE FATIGUE-CONSTANTS
	Target Reliability	ASSIGN TARGET-RELIABILITY
	Inspection Quality	ASSIGN INSPECTION-QUALITY
Inspection -		
	Create Inspection	CREATE INSPECTION
	Repair	ASSIGN REPAIR
	Delete Inspection	DELETE INSPECTION
	Print Inspection	PRINT INSPECTION
SCF -		
	Assign SCF	ASSIGN SCF

	Model Factor	ASSIGN MODEL-FACTOR SCF
Influence Coefficients -		
	Assign Influence Coefficients	ASSIGN INFLUENCE-COEFFICIENTS
	Model Factor	ASSIGN MODEL-FACTOR INFLUENCE-COEFFI-CIENTS
Uncertainty -		
	Change Uncertainty	ASSIGN UNCERTAINTY VALUE
	Print Uncertainty	PRINT UNCERTAINTY VALUE
	Change Definition	DEFINE UNCERTAINTY
	Print Definition	PRINT UNCERTAINTY DEFINITION
Variable -		
	Create Variable	CREATE VARIABLE
	Change Variable	CHANGE VARIABLE
	Delete Variable	DELETE VARIABLE
	Copy Variable	COPY VARIABLE
	Rename Variable	RENAME VARIABLE
	Extreme Type	ASSIGN EXTREME-VALUE
	Function Option	ASSIGN FUNCTION-OPTION
	Conditioning	ASSIGN CONDITIONING
	Display Distribution	DISPLAY DISTRIBUTION
	Display Fitted Distribution	DISPLAY FITTED-DISTRIBUTION
	Print Variable	PRINT VARIABLE
	Print Distribution	PRINT DISTRIBUTION
Correlation -		
	Correlate Variables	ASSIGN CORRELATION
	Print Correlation	PRINT CORRELATION
Event -		

Create Event	CREATE EVENT
Change Event	CHANGE EVENT
Delete Event	DELETE EVENT
Copy Event	COPY EVENT
Rename Event	RENAME EVENT
Measured Value	ASSIGN MEASURED-VALUE
Display Event	DISPLAY EVENT
Print Event	PRINT EVENT

Function -

Create Function	CREATE FUNCTION
Change Function	CHANGE FUNCTION
Delete Function	DELETE FUNCTION
Rename Function	RENAME FUNCTION
Display Function	DISPLAY FUNCTION
Print Function Formula	PRINT FUNCTION FORMULA
Function Option	ASSIGN FUNCTION-OPTION
Select Library	SELECT FUNCTION-LIBRARY
Presentation Options	DEFINE PRESENTATION FUNCTION
Print Description	PRINT FUNCTION DESCRIPTION
Print Value	PRINT FUNCTION VALUE
Print Gradient	PRINT FUNCTION GRADIENT
Print Library	PRINT FUNCTION LIBRARY

5.1.4 The Load menu

This menu contains commands used to model the long term stress range distribution, environment and transfer functions.

Transfer Function -

Create Transfer Function	CREATE TRANSFER-FUNCTION
Change Transfer Function	CHANGE TRANSFER-FUNCTION
Delete Transfer Function	DELETE TRANSFER-FUNCTION
Display Transfer Function	DISPLAY TRANSFER-FUNCTION
Print Transfer Function	PRINT TRANSFER-FUNCTION

Transfer Function Options	DEFINE TRANSFER-FUNCTION
Transfer Function Presentation	DEFINE PRESENTATION TRANSFER-FUNCTION
Assign Transfer Function	ASSIGN TRANSFER-FUNCTION
Model Factor	ASSIGN MODEL-FACTOR TRANSFER-FUNCTION

Wave Spreading -

Create Wave Spreading	CREATE WAVE-SPREADING-FUNCTION
Change Wave Spreading	CHANGE WAVE-SPREADING-FUNCTION
Delete Wave Spreading	DELETE WAVE-SPREADING-FUNCTION
Display Wave Spreading	DISPLAY WAVE-SPREADING-FUNCTION
Print Wave Spreading	PRINT WAVE-SPREADING-FUNCTION

Wave Statistics -

Create Wave Statistics	CREATE WAVE-STATISTICS
Delete Wave Statistics	DELETE WAVE-STATISTICS
Print Wave Statistics	PRINT WAVE-STATISTICS
Assign Wave Direction	ASSIGN WAVE-STATISTICS
Wave Direction Probability	ASSIGN WAVE-DIRECTION-PROBABILITY
Wave Spectrum Shape	ASSIGN WAVE-SPECTRUM-SHAPE
Wave Spreading	ASSIGN WAVE-SPREADING-FUNCTION
Distribution Fit	ASSIGN WAVE-SCATTER-DISTRIBUTION
Model Factor, Distribution	ASSIGN MODEL-FACTOR SCATTER-DISTRIBUTION
Model Factor, Spectrum	ASSIGN MODEL-FACTOR WAVE-SPECTRUM-SHAPE
Model Factor, Spreading	ASSIGN MODEL-FACTOR WAVE-SPREADING

Stress Range -

Assign Stress Range	ASSIGN STRESS-RANGE
Display Stress Range	DISPLAY STRESS-RANGE
Probabilistic Fit Points	DEFINE WEIBULL-FIT PROBABILISTIC
Deterministic Fit Points	DEFINE WEIBULL-FIT DETERMINISTIC

5.1.5 The SN-Fatigue Menu

This menu contains commands used to set up and execute SN based fatigue analysis, and to examine the results.

SN Curve -

Create SN Curve	CREATE SN-CURVE
Change SN Curve	CHANGE SN-CURVE
Delete SN Curve	DELETE SN-CURVE
Display SN Curve	DISPLAY SN-CURVE
Print SN Curve	PRINT SN-CURVE
Thickness Correction	ASSIGN THICKNESS-CORRECTION
Assign SN Curve	ASSIGN SN-CURVE
Critical Miner Sum	ASSIGN MINER-SUM-CRITICAL

Life Time Analysis -

Run Analysis	RUN SN-ANALYSIS LIFE-TIME
Display Result	DISPLAY SN-ANALYSIS LIFE-TIME
Print Result	PRINT SN-ANALYSIS LIFE-TIME

Failure Analysis -

Analysis Options	DEFINE SN-ANALYSIS FAILURE-PROBABILITY
Run Analysis	RUN SN-ANALYSIS FAILURE-PROBABILITY
Display Result	DISPLAY SN-ANALYSIS FAILURE-PROBABILITY
Print Result	PRINT SN-ANALYSIS FAILURE-PROBABILITY
Update Analysis Model	RUN SN-ANALYSIS UPDATE-MODEL

5.1.6 The Crack-Growth Menu

This menu contains commands used to set up and execute a crack growth based analysis, and to examine the results.

Crack Growth Model — ASSIGN CRACK-GROWTH-MODEL

Geometry Function -

Assign Geometry Function	ASSIGN GEOMETRY-FUNCTION

	Model Factor	ASSIGN MODEL-FACTOR GEOMETRY-FUNCTION
	Display Geometry Function	DISPLAY GEOMETRY-FUNCTION
Weld Effect -		
	Assign Weld Effect	ASSIGN WELD-EFFECT
	Model Factor	ASSIGN MODEL-FACTOR WELD-EFFECT
	Display Weld Effect	DISPLAY WELD-EFFECT
	Define PD6493 cutoff value	DEFINE CUTOFF-PD6493
Calibrate to SN -		
	Calibration Options	DEFINE CRACK-GROWTH-CALIBRATION
	Run Calibration	RUN CRACK-GROWTH-CALIBRATION
	Display Result	DISPLAY CRACK-GROWTH-CALIBRATION
	Print Result	PRINT CRACK-GROWTH-CALIBRATION
Life Time Analysis -		
	Run Analysis	RUN CRACK-GROWTH-ANALYSIS LIFE-TIME
	Display Result	DISPLAY CRACK-GROWTH-ANALYSIS LIFE-TIME
	Print Result	PRINT CRACK-GROWTH-ANALYSIS LIFE-TIME
Failure Analysis -		
	Analysis Options	DEFINE CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY
	Run Analysis	RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY
	Presentation Options	DEFINE PRESENTATION CRACK-GROWTH-ANALYSIS
	Display Result	DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY
	Print Result	PRINT CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY
	Update Analysis Model	RUN CRACK-GROWTH-ANALYSIS UPDATE-MODEL

5.1.7 The Plan Menu

This menu contains commands used to set up and execute an inspection plan, and to examine the results.

Target Reliability	ASSIGN TARGET-RELIABILITY
Inspection Quality	ASSIGN INSPECTION-QUALITY
Inspection Plan Options	DEFINE PLAN-INSPECTION

Run Inspection Planning	RUN PLAN-INSPECTION
Print Inspection Plan	PRINT PLAN-INSPECTION
Delete Inspection Plan	DELETE PLAN-INSPECTION

5.1.8 The Analysis Menu

This menu contains commands used to set up and execute probabilistic and deterministic analysis in general. Results from such an analysis are examined by use of the “Result” menu.

Select Analysis Method	SELECT ANALYSIS-METHOD
General Analysis Setup	DEFINE ANALYSIS-OPTION
Sensitivity Calculation -	
Selection	ASSIGN SENSITIVITY VARIABLE
Increment	ASSIGN SENSITIVITY INCREMENT
Parameter Study	DEFINE PARAMETER-STUDY
Run Analysis -	
Probability	RUN PROBABILITY-ANALYSIS
Distribution	RUN DISTRIBUTION-ANALYSIS
Deterministic	RUN DETERMINISTIC-ANALYSIS
Restart Simulation	RUN RESTART
FORM/SORM Analysis Setup	
General FORM/SORM Setup	DEFINE FORM-SORM
Optimization Bounds	ASSIGN OPTIMISATION-BOUNDS
Starting Point	ASSIGN STARTING-POINT
Generated Distribution	DEFINE FORM-SORM GENERATED-DISTRIBUTION
Probability Simulation Setup	
Axis Orthogonal Simulation	DEFINE PROBABILITY-SIMULATION AXIS-ORTHOGONAL
Directional Simulation	DEFINE PROBABILITY-SIMULATION DIRECTIONAL

Design Point Simulation	DEFINE PROBABILITY-SIMULATION DESIGN-POINT
Monte Carlo Simulation	DEFINE PROBABILITY-SIMULATION MONTE-CARLO

Distribution Analysis Setup

Simulation	DEFINE DISTRIBUTION-SIMULATION
Mean Value FORM	DEFINE MEAN-VALUE-FORM

Print

Analysis Setup	PRINT ANALYSIS-SETTINGS
Parameter Study	PRINT PARAMETER-STUDY
FORM/SORM Starting Point	PRINT STARTING-POINT

5.1.9 The Result Menu

This menu contains commands used to access results created while running probabilistic or deterministic analysis.

The results created during general probabilistic or deterministic analysis must be accessible through this menu.

The results created during SN analysis and crack growth analysis are accessible through this menu as well as through the “SN-Fatigue” and “Crack-Growth” menus.

Save Result	SAVE RESULT
Select Result	SELECT RESULT
Delete Result	DELETE RESULT
Rename Result	RENAME RESULT
Result Presentation	DEFINE PRESENTATION RESULT

Display Result -

Distribution	DISPLAY RESULT DISTRIBUTION
Importance Factors	DISPLAY RESULT IMPORTANCE-FACTORS
Parameter Study, Main Result	DISPLAY RESULT PARAMETER-STUDY MAIN-RESULT
Parameter Study, Importance	DISPLAY RESULT PARAMETER-STUDY IMPORTANCE-FACTOR

Print Result -

Analysis Settings	PRINT RESULT ANALYSIS-SETTINGS
Summary	PRINT RESULT SUMMARY All PRINT RESULT ALL
Importance Factors	PRINT RESULT IMPORTANCE-FACTORS
Sensitivity	PRINT RESULT SENSITIVITY
Sample	PRINT RESULT SAMPLE
Parameter Study, Main Result	PRINT RESULT PARAMETER-STUDY MAIN-RESULT
Parameter Study, Importance	PRINT RESULT PARAMETER-STUDY IMPORTANCE-FACTOR
Intermediate Results	PRINT RESULT INTERMEDIATE-RESULTS

5.1.10 The Options Menu

This menu contains the commands available in the line mode SET command, i.e. print and display settings.

Company Name		SET COMPANY-NAME
Display		SET DISPLAY
Drawing		SET DRAWING
Graph -		
	Lines and Markers	SET GRAPH LINE-OPTIONS
	X Axis	SET GRAPH X-AXIS-ATTRIBUTES
	Y Axis	SET GRAPH Y-AXIS-ATTRIBUTES
	Z Axis	SET GRAPH Z-AXIS-ATTRIBUTES
	Histogram	SET GRAPH HISTOGRAM
	Pie Chart	SET GRAPH PIE-CHART
Plot		SET PLOT
Print		SET PRINT
Title		SET TITLE

5.1.11 The Help Menu

The contents of the Help menu is the same as is described with the HELP command in the next section.

5.2 Line Mode Command Syntax

This section describes the complete syntax of the line mode command input. The commands are presented alphabetically. As the line mode input is case insensitive, all alternatives are presented in upper case.

ASSIGN

ASSIGN	CONDITIONING	...
	CORRELATION	...
	CRACK-GROWTH-MODELL	...
	EXTREME-VALUE	...
	FUNCTION-OPTION	...
	GEOMETRY-FUNCTION	...
	INFLUENCE-COEFFICIENTS	...
	INSPECTION-QUALITY	...
	MEASURED-VALUE	...
	MINER-SUM-CRITICAL	...
	MODEL-FACTOR	...
	OPTIMISATION-BOUNDS	...
	REPAIR	...
	SCF	...
	SENSITIVITY-CALCULATION	...
	SN-CURVE	...
	STARTING-POINT	...
	STRESS-RANGE	...
	TARGET-RELIABILITY	...
	THICKNESS-CORRECTION	...
	TRANSFER-FUNCTION	...
	UNCERTAINTY-VALUE	...
	WAVE-DIRECTION-PROBABILITY	...
	WAVE-SCATTER-DISTRIBUTION	...
	WAVE-SPECTRUM-SHAPE	...
	WAVE-SPREADING-FUNCTION	...
	WAVE-STATISTICS	...
	WELD-EFFECT	...

PURPOSE:

Assign attribute(s) to one or more named objects.

PARAMETERS:

CONDITIONING	Assign conditioning variables to a generated distribution variable.
CORRELATION	Assign correlation between random variables.
CRACK-GROWTH-MODEL	Assign the model used for crack growth analysis to a fatigue point or an inspection with a repair assigned.
EXTREME-VALUE	Assign extreme value distribution type to a random variable.
FUNCTION-OPTION	Assign optional function input to a random variable that is a function of other variables, or to a model function.
GEOMETRY-FUNCTION	Assign the geometry function used for crack growth analysis to a fatigue point or an inspection with a repair assigned.
INFLUENCE-COEFFICIENTS	Assign influence coefficients to a fatigue point or an inspection with a repair assigned, for calculation of the stress range.
MEASURED-VALUE	Assign the measured value to an event with equality constraint.
MINER-SUM-CRITICAL	Assign an SN analysis model to a fatigue point.
MODEL-FACTOR	Assign factors (model correction) to some parts of the model.
OPTIMISATION-BOUNDS	Assign bounds to a variable, limiting the range of values allowed in FORM/SORM optimization.
REPAIR	Assign repair condition to an inspection.
SCF	Assign stress concentration factors to a fatigue point or an inspection with a repair assigned.
SENSITIVITY-CALCULATION	Assign sensitivity calculation and increment to parameters.
SN-CURVE	Assign an SN-curve to a fatigue point or an inspection with a repair assigned.
STARTING-POINT	Assign a starting point for the FORM/SORM analysis to an event.
STRESS-RANGE	Assign the stress range to a fatigue point or an inspection with a repair assigned.
TARGET-RELIABILITY	Assign a target reliability to one or more fatigue points. This value defines when an inspection is required.

THICKNESS-CORRECTION	Assign thickness correction to an SN-curve.
TRANSFER-FUNCTION	Assign transfer functions for use in the calculation of the Sum-Rayleigh stress range distribution.
UNCERTAINTY VALUE	Assign uncertainty value to parameters in the model.
WAVE-DIRECTION-PROBABILITY	To assign the probability of a wave direction.
WAVE-SCATTER-DISTRIBUTION	To assign a distribution fit to the wave scatter diagram during calculation of the Sum-Rayleigh long term stress distribution.
WAVE-SPECTRUM-SHAPE	To assign wave spectrum shape to wave statistics.
WAVE-SPREADING-FUNCTION	To assign wave spreading function to wave statistics.
WAVE-STATISTICS	To assign wave statistics to a wave direction.

NOTES:

None.

ASSIGN CONDITIONING

...	CONDITIONING	variable	condvar+

PURPOSE:

Assign conditioning variable(s) to a generated distribution variable.

PARAMETERS:

variable	The name of a generated distribution variable.
condvar+	A selection of variables that are kept fixed when the distribution is generated.

NOTES:

1 The current conditioning variables are presented as defaults when a generated distribution variable is selected.

2 The conditioning assignment to a variable is printed by use of the PRINT VARIABLE command.

See also:

- CREATE VARIABLE ... GENERATED
- PRINT VARIABLE

EXAMPLES:

```
ASSIGN CONDITIONING GenVar ( ONLY A B C )
ASSIGN CONDITIONING GenVar ( EXCLUDE * )
```

ASSIGN CORRELATION

<table>
<tr><td rowspan="3">...</td><td rowspan="3">CORRELATION</td><td rowspan="3">univariate+</td><td>BASIC</td><td>value</td></tr>
<tr><td>NORMALIZED</td><td>value</td></tr>
<tr><td colspan="2">NONE</td></tr>
</table>

PURPOSE:

Assign the same correlation (or no correlation) to a number of variables.

PARAMETERS:

univariate+	A selection of variables that are defined as one dimensional distributions with numerical or fixed parameter values. All pairs of the selected variables will be assigned the specified correlation.
BASIC	The correlation is specified in the physical space.
NORMALIZED	The correlation is specified in the transformed standard normal space.
value	Correlation value. Can be a numerical value or the name of a one dimensional variable.

NOTES:

1 It is possible to do sensitivity analysis on correlation coefficients by creating them as fixed variables first, then using the fixed variable to specify the correlation value (see example below).

See also:

- PRINT CORRELATION

EXAMPLES:

```
ASSIGN CORRELATION ( P-lnC P-m ) BASIC -0.9
CREATE VARIABLE StrCorr ’Stress Correlation’ FIXED 0.8
ASSIGN CORRELATION (FP-lnA FP-1dB ) NORMALIZED. StrCorr
ASSIGN SENSITIVITY VARIABLE INCLUDE StrCorr
ASSIGN CORRELATION PP* NONE
```

ASSIGN CRACK-GROWTH-MODEL

...	CRACK-GROWTH-MODEL	fatigpnt/inspec	InitTime	...

...	PARIS-1DIM	lnC, m	...	NO-THRESHOLD
	SHANG	lnC, m		DK0
	PARIS-2DIM	lnCa, m, Ca/Cc		

PURPOSE:

Assign the crack growth analysis model to a fatigue point or to an inspection with a repair assigned.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection with a repair assigned. This is referred to as NAME in the naming of stochastic parameters below.
InitTime	Crack initiation time. Uncertainty can be assigned to the parameter NAME-ITime.
PARIS-1DIM	One dimensional crack growth model, using Paris law.
lnC	ln(C), material parameter. Please take care to specify this for the correct units. See also Section 3.7.1 and Table 3.1. Uncertainty can be assigned to the parameter NAME-lnC.
m	m, material parameter. See also Section 3.7.1 and Table 3.1. Uncertainty can be assigned to the parameter NAME-m.
NO-THRESHOLD	Paris law is used with no threshold value.
DK0	Threshold value. Uncertainty can be assigned to the parameter NAME-DK0.
SHANG	One dimensional crack growth model, where the aspect ratio is a function of the crack depth, thus simulating two dimensional crack growth behaviour.
lnCa	ln(Ca), material parameter. Please take care to specify this for the correct units. See also Section 3.7.1 and Table 3.1. Uncertainty can be assigned to the parameter NAME-lnCa.
Ca/Cc	(Ca/Cc)**(1/m). Usually set to 1.1. Uncertainty can be assigned to the parameter NAME-CaC.
PARIS-2DIM	Two dimensional crack growth model using Paris law.

NOTES:

1 To change the uncertainty of a parameter, use the command ASSIGN UNCERTAINTY VALUE.

2 The crack growth model assignment can be printed by use of the command PRINT FATIGUE-POINT or PRINT INSPECTION.

See also:

- ASSIGN GEOMETRY-FUNCTION
- ASSIGN WELD-EFFECT
- ASSIGN UNCERTAINTY VALUE
- PRINT FATIGUE-POINT
- PRINT INSPECTION

EXAMPLES:

```
ASSIGN CRACK-GROWTH-MODEL FATIGUE-POINT C3501 2 PARIS-1DIM -31 3.0 NO-THRESHOLD
ASSIGN CRACK-GROWTH-MODEL FATIGUE-POINT C3502 2 PARIS-1DIM -31 3.0 200.0
```

ASSIGN EXTREME-VALUE

<table>
<tr><td rowspan="3">...</td><td rowspan="3">EXTREME-VALUE</td><td rowspan="3">variable</td><td>MIN-OF-N</td><td>n_min</td></tr>
<tr><td>MAX-OF-N</td><td>n_max</td></tr>
<tr><td colspan="2">NONE</td></tr>
</table>

PURPOSE:

Assign extreme type to a distribution variable.

PARAMETERS:

variable	A one dimensional distribution variable or a generated distribution variable.
MIN-OF-N n_min	The extreme distribution is the minimum of n_min independent, identically distributed variables with the distribution that was input when the selected variable was created/changed. n_min must be a positive whole number.
MAX-OF-N n_max	The extreme distribution is the maximum of n_max independent, identically distributed variables with the distribution that was input when the selected variable was created/changed. n_max must be a positive whole number.
NONE	No extreme type distribution is used for this variable.

NOTES:

1 All variables have by default no extreme type assigned.

2 The extreme value assignment is printed by use of the PRINT VARIABLE command.

See also:

- PRINT VARIABLE

EXAMPLES:

```
ASSIGN EXTREME-VALUE Amplitude MAX-OF-N 5
ASSIGN EXTREME-VALUE Amplitude NONE
```

ASSIGN FUNCTION-OPTION

<table>
<tr><td rowspan="2">...</td><td rowspan="2">FUNCTION-OPTION</td><td>FUNCTION</td><td>function</td><td rowspan="2">option</td><td rowspan="2">value</td></tr>
<tr><td>VARIABLE</td><td>variable</td></tr>
</table>

PURPOSE:

Assign input, that is not of random or numerical nature, to a model function.

PARAMETERS:

FUNCTION	Assign the value directly to a function. In this case it is applied to all variables created by use of the function (until changed again).
function	Name of the function to which the value is assigned.
VARIABLE	Assign the value to a variable that is based on a model function. This assignment affects only the selected variable, not any other variables based on the same function.
variable	Name of the variable to which the value is assigned.
option	The option to be defined. The range of available options varies from function to function.
value	The value of the option. This will be either a whole number, a floating point number, a text, a file name or a selection between alternatives, dependent on the selected option.

NOTES:

1 The default function options can be printed by use of the PRINT FUNCTION DESCRIPTION command.

2 The function options assigned to a variable are printed by use of the PRINT VARIABLE command.

3 The function options assigned to the variables created by this program should not be changed by the user.

See also:

- PRINT FUNCTION DESCRIPTION
- PRINT VARIABLE

EXAMPLES:

```
ASSIGN FUNCTION-OPTION FUNCTION F11 POWER 3
ASSIGN FUNCTION-OPTION VARIABLE VAR33 ACCURACY-TYPE RELATIVE
ASSIGN FUNCTION-OPTION VARIABLE VAR33 ACCURACY-VALUE 1.1E-5
```

ASSIGN GEOMETRY-FUNCTION

...	GEOMETRY-FUNCTION	fatigpnt/inspect	...

...	PLATE-CENTER	a0,acr,MemStr	
	PLATE-EDGE	a0,acr,MemStr	
	PLATE-SURFACE-1D	DEPTH	a0,acr,a/c,MemStr
		LENGTH	c0,ccr,a/c,MemStr
	PLATE-SURFACE-2D	DEPTH	a0,acr,ccr,a/c,MemStr
		LENGTH	c0,acr,ccr,a/c,MemStr
	TUBE-SURFACE	DEPTH	a0,acr,a/c,MemStr
	POLYNOMIAL	DEPTH	a0,acr,a/c,Polycoefs
		LENGTH	c0,ccr,a/c,Polycoefs
	DATA-FIT	DEPTH	a0,acr,a/c,x,Gmf*
		LENGTH	c0,ccr,a/c,x,Gmf*

PURPOSE:

Assign the geometry function to use for crack growth analysis to a fatigue point or an inspection with a repair assigned.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection with a repair assigned. This is referred to as NAME in the naming of stochastic parameters below.
PLATE-CENTER	Through thickness crack, centred in a plane plate.
a0	Initial crack depth. Uncertainty can be assigned to the parameter NAME-a0.
acr	Critical crack depth. Uncertainty can be assigned to the parameter NAME-acr.
MemStr	Membrane-stress ratio (mem/(mem+ben)). Uncertainty can be assigned to the parameter NAME-MSRatio.
PLATE-EDGE	Through thickness crack, at the edge of a plane plate.
PLATE-SURFACE-1D	Surface crack in a plane plate, using the Raju-Newman solution. and the one dimensional crack growth model.
PLATE-SURFACE-2D	Surface crack in a plane plate, using the Raju-Newman solution. and a two dimensional crack growth model.
DEPTH	The crack depth is critical.

LENGTH	The crack length is critical.
c0	Initial crack length (2*c0 is the full length). Uncertainty can be assigned to the parameter NAME-c0.
a/c	Aspect ratio a/c. Uncertainty can be assigned to the parameter NAME-acRatio.
ccr	Critical crack length (2*ccr is the full length). Uncertainty can be assigned to the parameter NAME-2ccr.
TUBE-SURFACE	Surface crack in tube, circular in outer diameter. The crack length propagates perpendicular to the direction of the tube.
POLYNOMIAL	Polynomial geometry function, with x = (2c)/Width or a/Thick, of the form: (c_1 - c_2*x + c_3*x2)* (1 + c_4*Exp(-c_5*x) + c_6*Exp(-c_7*(x**c_8))
PolyCoefs	8 coefficients defining a polynomial. Uncertainty can be assigned to the parameter NAME-c1Pol, NAME-c2Pol, ..., NAME-c8Pol.
DATA-FIT	Geometry function fitted to input data.
x,Gmf*	A set of geometry function values at different depths or lengths x.

NOTES:

1 A crack growth model must be assigned to the fatigue point before a geometry function can be assigned.

2 The PARIS-2DIM options only allow specification of a PLATE-SURFACE-2D geometry function. The PARIS-1DIM and SHANG options only allow specification of all the other geometry functions.

3 The TUBE-SURFACE geometry function is only available if the fatigue point has a tube geometry.

4 To change the uncertainty of a parameter, use the command ASSIGN UNCERTAINTY VALUE.

5 The geometry function assignment can be printed by use of the command PRINT FATIGUE-POINT.

6 A one dimensional geometry function can be displayed by use of the command DISPLAY GEOMETRY-FUNCTION.

7 The initial version of Profast contained an extra geometry function applicable to K joints, which was fitted to the PLATE-SURFACE function in the depth direction with MemStr = 0.25 and a/c = 0.15, and with a weld effect applied. This function has been removed, but can be reconstructed by use of the POLYNOMIAL function with coefficients: 1.08 0.7 0.0 1.24 22.1 3.17 357.0 1.0.

See also:

- ASSIGN CRACK-GROWTH-MODEL
- ASSIGN WELD-EFFECT
- ASSIGN UNCERTAINTY VALUE

- RUN CALIBRATION-CRACK-GROWTH
- DISPLAY GEOMETRY-FUNCTION
- PRINT FATIGUE-POINT
- PRINT INSPECTION

EXAMPLES:

```
ASSIGN GEOMETRY-FUNCTION C3501 PLATE-CENTER 1 25 25 0.4
ASSIGN CRACK-GROWTH-MODEL C3502 PLATE-SURFACE LENGTH 4 0.2 25 1000 0.1 0.4
```

ASSIGN INFLUENCE-COEFFICIENTS

<table>
<tr><td rowspan="2">...</td><td rowspan="2">INFLUENCE-COEFFICIENTS</td><td rowspan="2">fatigpnt/inspect</td><td colspan="3">NONE</td></tr>
<tr><td>{</td><td>Coef,Fact</td><td>}*</td></tr>
</table>

PURPOSE:

Assign the influence coefficients for calculation of the stress range to a fatigue point or an inspection with repair assigned.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection with a repair assigned. This is referred to as NAME in the naming of stochastic parameters below.
NONE	No influence coefficients are assigned.
Coef,Fact	Influence coefficients Coef and factors Fact. Each factor is multiplied with the corresponding coefficient at the calculation of the stress range. Uncertainty in the coefficient can be assigned to the parameter named NAME-Ixx, with xx being the number of the coefficient.

NOTES:

1 Uncertainty in the influence coefficients can also be accounted for by a single multiplicative factor, with a default value of 1. The value is represented by the variable named NAME-IFactor. This variable has no uncertainty by default.

2 To change the uncertainty of a parameter, use the command ASSIGN UNCERTAINTY VALUE.

3 During the calculation of the stress range distribution as a sum of Rayleigh distributions, the input values here are applied as: Σ $Force_i$ * $Coef_i$ * $Fact_i$

4 Force transfer functions corresponding to the influence coefficients must be assigned through the command ASSIGN TRANSFER-FUNCTION.

5 Fatigue points located at a JOINT or MEMBER have by default parametric SCFs, calculated when running Framework, when possible. These values may be overridden by the direct specification of influence coefficients if desired. If this is done, the user must also take responsibility for correctly creating and assigning transfer functions to the influence coefficients.

6 The influence coefficient assignment can be printed by use of the command PRINT FATIGUE-POINT or PRINT INSPECTION.

7 Note that the stress range assigned to the fatigue point is not changed until an ASSIGN STRESS-RANGE command is issued.

See also:

- ASSIGN SCF
- ASSIGN TRANSFER-FUNCTION
- ASSIGN STRESS-RANGE
- PRINT FATIGUE-POINT
- PRINT INSPECTION

EXAMPLES:

```
ASSIGN INFLUENCE-COEFFICIENTS FATIGUE-POINT C3501 ( ONLY 0.015 1 0.32 1 1.45 1 )
```

ASSIGN INSPECTION-QUALITY

...	INSPECTION-QUALITY	fatigpnt+	DEPTH	POD
			LENGTH	

PURPOSE:

Assign the inspection quality to be used at planned inspections of a fatigue point.

PARAMETERS:

fatigpnt+	A selection of names of fatigue points.
DEPTH	The depth of the crack will be inspected.
LENGTH	The length of the crack will be inspected.
POD	The POD curve (Probability Of Detection) describing the inspection quality. This is the name of a random variable.

NOTES:

1 The inspection quality is used to define future inspections in an inspection plan.

2 See also Section 2.6 and Section 3.8.2.

3 The inspection quality assignment can be printed by use of the command PRINT FATIGUE-POINT.

See also:

- PRINT FATIGUE-POINT
- ASSIGN TARGET-RELIABILITY
- RUN PLAN-INSPECTION

EXAMPLES:

```
ASSIGN INSPECTION-QUALITY C35* PODL-MPI-UW
ASSIGN INSPECTION-QUALITY C3501 PODL-Eddy-Cu
```

ASSIGN MEASURED-VALUE

<table>
<tr><td rowspan="2">...</td><td rowspan="2">MEASURED-VALUE</td><td rowspan="2">event</td><td>variable</td></tr>
<tr><td>NONE</td></tr>
</table>

PURPOSE:

Assign the measured value to an equality event

PARAMETERS:

event	The name of an event of type SINGLE.
variable	The name of the variable which was measured. This may be a coordinate in a multidimensional variable.
NONE	No measured value is assigned to the selected event.

NOTES:

1 By default no measured variable is assigned to any event, except the events describing inspections where a crack is measured to a certain size.

2 The measured value assigned to an event is printed by use of the PRINT EVENT command.

3 The measured value assignments to the events created by this program should not be changed by the user.

See also:

- PRINT EVENT

EXAMPLES:

```
ASSIGN MEASURED-VALUE FindCrack am
```

ASSIGN MINER-SUM-CRITICAL

...	MINER-SUM-CRITICAL	fatigpnt/inspect	damage

PURPOSE:

Assign critical SN damage value to a fatigue point or an inspection with repair assigned.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection with repair assigned. This is referred to as NAME in the naming of stochastic parameters below.
damage	The critical amount of damage (Miner sum at failure). Uncertainty can be assigned to the parameter NAME-MinerS.

NOTES:

The Miner sum assignment can be printed by use of the command PRINT FATIGUE-POINT.

See also:

- ASSIGN SN-CURVE
- ASSIGN STRESS-RANGE
- RUN PROBABILITY-ANALYSIS
- RUN DETERMINISTIC-ANALYSIS
- PRINT FATIGUE-POINT

EXAMPLES:

```
ASSIGN MINER-SUM-CRITICAL C3501 1.0 NONE
```

ASSIGN MODEL-FACTOR

...	MODEL-FACTOR	...

...	GEOMETRY-FUNCTION	fatigpnt/inspect, GFactor
	INFLUENCE-COEFFICIENTS	fatigpnt/inspect, IFactor
	SCF	fatigpnt/inspect, SFactor
	TRANSFER-FUNCTION	fatigpnt/inspect, a, b, c, fRSP
	SCATTER-DISTRIBUTION	scatter, fEHS, fSHS, fETZ, fSTZ, fCorr, fSkew
	WAVE-SPECTRUM-SHAPE	scatter, fgamma, fsigmaA, fsigmaB, fL, fN
	WAVE-SPREADING	scatter, fPower
	WELD-EFFECT	fatigpnt/inspect, SFactor

PURPOSE:

Assign factors in order to modify the model (e.g. to account for model uncertainty).

PARAMETERS:

GEOMETRY-FUNCTION	Assign factor to be multiplied on a geometry function.
fatigpnt/inspect	The name of a fatigue point, or of an inspection with a repair assigned. This is referred to as NAME in the naming of stochastic parameters below.
INFLUENCE-COEFFICIENTS	Assign factor to be multiplied on all influence coefficients.
SCF	Assign factor to be multiplied on all stress concentration factors.
SCATTER-DISTRIBUTION	Assign factors to the parameters of the distribution fitted to the scatter diagram. These factors are used only when a distribution has been fitted to the scatter diagram.
scatter	The name of a wave scatter diagram. This is referred to as NAME in the naming of stochastic parameters below.
fEHS	Factor on the mean of H_S. Uncertainty may be applied to the stochastic parameter NAME-EHS.
fSHS	Factor on the standard deviation of H_S. Uncertainty may be applied to the stochastic parameter NAME-SHS.
fETZ	Factor on the mean of T_Z. Uncertainty may be applied to the stochastic parameter NAME-ETZ..

fSTZ	Factor on the standard deviation of T_Z. Uncertainty may be applied to the stochastic parameter NAME-STZ.
fCorr	Factor on the correlation between H_S and Tz. Uncertainty may be applied to the stochastic parameter NAME-CHT.
fSkew	Factor on the skewness in a fitted Fang-Hogben distribution. Uncertainty may be applied to the stochastic parameter NAME-FHS.
TRANSFER-FUNCTION	Assign factors to the value of the transfer function and the stress response.
a, b, c	The factor on the transfer function is a function of H_S as follows: factor = a + b * Hs + c * H_S^2. Uncertainty may be applied to the stochastic parameters NAME-aTRF, NAME-bTRF, NAME-cTRF.
fRSP	Factor on the stress response (the square modulus of the transfer function). Uncertainty may be applied to the stochastic parameter NAME-RSP.
WAVE-SPECTRUM-SHAPE	Assign a factor to the parameters of a wave spectrum assigned to a scatter diagram.
fgamma	Factor on the parameter gamma in a Jonswap spectrum. Uncertainty may be applied to the stochastic parameter NAME-GWS.
fsigmaA	Factor on the parameter sigmaA in a Jonswap spectrum. Uncertainty may be applied to the stochastic parameter NAME-AWS.
fsigmaB	Factor on the parameter sigmaB in a Jonswap spectrum. Uncertainty may be applied to the stochastic parameter NAME-BWS.
fL	Factor on the parameter L in a General Gamma spectrum. Uncertainty may be applied to the stochastic parameter NAME-LWS.
fN	Factor on the parameter N in a General Gamma spectrum. Uncertainty may be applied to the stochastic parameter NAME-NWS.
WAVE-SPREADING	Assign a factor to the power of wave spreading functions assigned to a scatter diagram.
fPower	Factor on the power of a wave spreading function assigned to a scatter diagram. Uncertainty may be applied to the stochastic parameter NAME-PWS.
WELD-EFFECT	Assign factor to be multiplied on a weld effect value.

NOTES:

1 To change the uncertainty of a parameter, use the command ASSIGN UNCERTAINTY VALUE.

2 The current values can be printed by use of the command PRINT UNCERTAINTY VALUE.

3 The bivariate distribution type fitted to each scatter diagram is defined by use of ASSIGN WAVE-SCATTER-DISTRIBUTION.

4 Note that the stress range assigned to the inspection or fatigue point is not changed until an ASSIGN STRESS-RANGE command is issued.

See also:

- ASSIGN STRESS-RANGE
- ASSIGN WAVE-SCATTER-DISTRIBUTION
- ASSIGN UNCERTAINTY VALUE
- PRINT UNCERTAINTY VALUE
- PRINT FATIGUE-POINT
- PRINT INSPECTION

EXAMPLES:

The default assignments to a new fatigue point or scatter diagram are:

```
ASSIGN MODEL-FACTOR SCATTER-DISTRIBUTION NEWSCAT 1 1 1 1 1 1
ASSIGN MODEL-FACTOR WAVE-SPECTRUM-SHAPE NEWSCAT 1 1 1 1 1
ASSIGN MODEL-FACTOR TRANSFER-FUNCTION NEWFATP 1 0 0 1
```

ASSIGN OPTIMISATION-BOUNDS

...	OPTIMISATION-BOUNDS	variable	MODEL-SPACE	...	lower	...	upper
			U-SPACE		OFF		OFF

PURPOSE:

Assign bounds on variables, to be used in FORM/SORM optimization.

PARAMETERS:

variable	Name of the variable to which the bounds are assigned. This is a one dimensional distribution variable, or a generated distribution variable.
MODEL-SPACE	The bounds are specified in model space (physical input values).
U-SPACE	The bounds are specified in the transformed normal space.
lower	The value of the lower bound.
upper	The value of the upper bound.
OFF	The default bound is used.

NOTES:

The optimization bounds assigned to a variable are printed by use of the PRINT VARIABLE command.

See also:

- PRINT VARIABLE

EXAMPLES:

```
ASSIGN OPTIMISATION-BOUNDS Amplitude MODEL-SPACE 0 OFF
ASSIGN OPTIMISATION-BOUNDS Load U-SPACE -20 20
```

ASSIGN REPAIR

<table>
<tr><td rowspan="2">...</td><td rowspan="2">REPAIR</td><td rowspan="2">inspect</td><td>GRIND</td><td rowspan="2">depth</td></tr>
<tr><td>NONE</td></tr>
</table>

PURPOSE:

Assign repair information to an inspection.

PARAMETERS:

inspect	The name of an inspection. This is referred to as NAME in the naming of stochastic parameters below.
GRIND	A grind repair was performed.
depth	Grind depth. Uncertainty in the value can be assigned to the parameter named NAME-Grind.
NONE	No repair was done.

NOTES:

1 It is currently not possible to change a repair type. Thus, the NONE alternative currently has no function.

2 The repair assignments can be printed by use of the command PRINT INSPECTION.

3 A Grind assignment has many effects on the model. See Section 3.8.4 for details.

See also:

- ASSIGN CRACK-GROWTH-MODEL
- ASSIGN STRESS-RANGE
- ASSIGN SCF FATIGUE-POINT
- ASSIGN INFLUENCE-COEFFICIENTS
- ASSIGN TRANSFER-FUNCTION FATIGUE-POINT
- PRINT INSPECTION

EXAMPLES:

```
ASSIGN REPAIR C3501 GRIND 6
```

ASSIGN SCF

...	SCF	fatigpnt/inspect	NONE
			SCF_axi, 1/area, SCF_ipb, z/Iy, SCF_opb, y/Iz

PURPOSE:

Assign stress concentration factors to a fatigue point or an inspection with a repair assigned.

PARAMETERS:

fatigpnt	The name of a fatigue point or an inspection with a repair assigned. This is referred to as NAME in the naming of stochastic parameters below.
NONE	No stress concentration factors are assigned.
SCF_axi	Axial stress concentration factor. Uncertainty can be assigned to the parameter NAME-ASCF.
1/area	Force to Stress transformation, Axial (1 / cross section area).
SCF_ipb	In-plane bending stress concentration factor. Uncertainty can be assigned to the parameter NAME-ISCF.
z/Iy	Force to Stress transformation, In-plane bending.
SCF_opb	Out of plane bending stress concentration factor. Uncertainty can be assigned to the parameter NAME-OSCF.
y/Iz	Force to Stress transformation, Out-of-plane bending.

NOTES:

1 Uncertainty in the SCFs can also be accounted for by a single multiplicative factor, with a default value of 1. The value is represented by the variable named NAME-SFactor. This variable has no uncertainty by default.

2 To change the uncertainty of a parameter, use the command ASSIGN UNCERTAINTY VALUE.

3 During the calculation of the stress range distribution as a sum of Rayleigh distributions, the input values here are applied as (where A is a force to stress transformation coefficient): $\Sigma\ Force_i * SCF_i * A_i$

4 Force transfer functions must be assigned through the command ASSIGN TRANSFER-FUNCTION.

5 Fatigue points located at a JOINT or MEMBER have by default parametric SCFs, calculated when running Framework, when possible. These values may be overridden by the direct specification of SCFs if desired. If this is done, the user must also take responsibility for correctly creating and assigning transfer functions to the SCFs.

6 The SCF assignment can be printed by use of the command PRINT FATIGUE-POINT or PRINT INSPECTION.

7 Note that the stress range assigned to the fatigue point is not changed until an ASSIGN STRESS-RANGE command is issued.

See also:

- ASSIGN INFLUENCE-COEFFICIENTS
- ASSIGN TRANSFER-FUNCTION
- ASSIGN STRESS-RANGE
- PRINT FATIGUE-POINT
- PRINT INSPECTION

EXAMPLES:

```
ASSIGN SCF C3501 2.5 2.341E-05 3.536 -1.001E-07 3.536 1.001E-07
```

ASSIGN SENSITIVITY-CALCULATION

<table>
<tr><td rowspan="2">...</td><td rowspan="2">SENSITIVITY-CALCULATION</td><td>INCREMENT</td><td rowspan="2">...</td></tr>
<tr><td>VARIABLE</td></tr>
</table>

PURPOSE:

Assign sensitivity calculation parameters and increments.

PARAMETERS:

INCREMENT	Assign increment value to be used for sensitivity calculation.
VARIABLE	Select parameters for sensitivity calculation.

NOTES:

None.

ASSIGN SENSITIVITY-CALCULATION INCREMENT

<table>
<tr><td rowspan="2">...</td><td rowspan="2">INCREMENT</td><td rowspan="2">parameter</td><td>value</td></tr>
<tr><td>DEFAULT</td></tr>
</table>

PURPOSE:

Assign increment to be used for sensitivity calculation.

PARAMETERS:

parameter	The parameter for which the increment applies. This can be a fixed variable, the name of a numerical parameter in a distribution variable, or the name of a numerical argument in a function variable.
value	The increment to be used.
DEFAULT	Use the default increment.

NOTES:

The specified increment overrides any increment specified by DEFINE ANALYSIS-OPTION DIFFERENTIATION.

See also:

- ASSIGN SENSITIVITY-CALCULATION VARIABLE

EXAMPLES:

```
ASSIGN SENSITIVITY-CALCULATION INCREMENT P1-lnC ON 0.01
ASSIGN SENSITIVITY-CALCULATION INCREMENT P1-lnC OFF
```

ASSIGN SENSITIVITY-CALCULATION VARIABLE

...	VARIABLE	parameter+

PURPOSE:

Select a number of parameters for sensitivity calculation.

PARAMETERS:

parameter+	The parameters to be used for sensitivity calculation. These can be a fixed variable, the name of a numerical parameter in a distribution variable, or the name of a numerical argument in a function variable.

NOTES:

1 The parameters that have previously been selected are presented as the default selection. To deassign sensitivity to some of these, remove them from the selection.

2 The command DEFINE ANALYSIS-OPTION SENSITIVITY is used to confirm or override the selection specified here.

See also:

- ASSIGN SENSITIVITY-CALCULATION INCREMENT
- DEFINE ANALYSIS-OPTION SENSITIVITY

EXAMPLES:

```
ASSIGN SENSITIVITY-CALCULATION VARIABLE *-Mean
ASSIGN SENSITIVITY-CALCULATION VARIABLE INCLUDE P1-lnC-Stdv
```

ASSIGN SN-CURVE

...	SN-CURVE	fatigpnt/inspect	sn_curve

PURPOSE:

Assign an SN-curve to a fatigue point or to an inspection with a repair assigned.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or of an inspection with a repair assigned.
sn_curve	The name of an SN-curve.

NOTES:

1 A number of default SN-curves are available - see chapter 2.

2 The SN-curve assignment to a fatigue point can be printed by use of the command PRINT FATIGUE-POINT or PRINT INSPECTION.

See also:

- ASSIGN MINER-SUM-CRITICAL
- RUN PROBABILITY-ANALYSIS
- PRINT FATIGUE-POINT
- PRINT INSPECTION

EXAMPLES:

```
ASSIGN SN-CURVE FATIGUE-POINT PDNV-T
```

ASSIGN STARTING-POINT

<table>
<tr><td rowspan="2">...</td><td rowspan="2">STARTING-POINT</td><td colspan="2">event</td><td rowspan="2">{</td><td>numerical</td><td rowspan="2">}*</td></tr>
<tr><td>VARIABLE</td><td>variable</td><td>DEFAULT</td></tr>
</table>

PURPOSE:

Assign a starting point for the FORM/SORM optimization to an event or a variable.

PARAMETERS:

event	Name of the event to which the starting point is assigned. This must be a single event.
VARIABLE	Assign the starting point to a variable. This must be a one dimensional distribution variable or a generated distribution variable. This assignment causes the starting point value to be used in all events that depend on the variable, except when overridden by a direct assignment to the event.
variable	Name of the variable to which the starting point is assigned.
numerical	Numerical starting point value. The value must be specified in the physical model space, not in U-space.
default	The text default implies a default starting point value, that is the origin in U-space.

NOTES:

1 The starting point assignment can be printed by use of the PRINT STARTING-POINT command.

2 The use of starting points in the FORM/SORM optimization is determined by the DEFINE FORM-SORM STARTING-POINT INITIAL command.

See also:

- PRINT STARTING-POINT
- DEFINE FORM-SORM STARTING-POINT INITIAL

EXAMPLES:

```
ASSIGN STARTING-POINT EP1 7.52 DEFAULT DEFAULT 2200 -8.65
ASSIGN STARTING-POINT VARIABLE VAR7 DEFAULT DEFAULT
```

ASSIGN STRESS-RANGE

<table>
<tr><td rowspan="7">...</td><td rowspan="7">STRESS-RANGE</td><td rowspan="7">fatigpnt/inspect</td><td colspan="2">NONE</td></tr>
<tr><td>CONSTANT</td><td>value, nu0</td></tr>
<tr><td>WEIBULL-AB</td><td>lnA, 1/B, nu0</td></tr>
<tr><td colspan="2">SUM-RAYLEIGH</td></tr>
<tr><td rowspan="3">WEIBULL-FIT</td><td>FRACTILE-95-99</td></tr>
<tr><td>DETERMINISTIC</td></tr>
<tr><td>PROBABILISTIC</td></tr>
</table>

PURPOSE:

Assign the stress range to a fatigue point or an inspection with a repair assigned.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection with a repair assigned. This is referred to as NAME in the naming of stochastic parameters below.
NONE	No stress range is assigned.
CONSTANT	The stress range is constant, except for any assigned uncertainty.
value	The constant stress range value. Uncertainty can be assigned to the parameter NAME-SRange.
nu0	The number of load cycles per second. This value is calculated automatically when the SUM-RAYLEIGH or WEIBULL-FIT options are used. Uncertainty can be assigned to the parameter NAME-nu0.
WEIBULL-AB	The stress range is Weibull distributed, with the parameters specified directly.
lnA	The logarithm of the scale parameter A in the Weibull distribution. Uncertainty can be assigned to the parameter NAME-lnA.
1/B	The reciprocal of the shape parameter B in the Weibull distribution. Uncertainty can be assigned to the parameter NAME-1dB
SUM-RAYLEIGH	The stress distribution is calculated as a sum of rayleigh distributions, each calculated from an environmental wave description, a set of force transfer functions and a number of stress concentration factors or influence coefficients.
WEIBULL-FIT	The stress range is Weibull distributed, fitted to the Sum-Rayleigh distribution described above. The fit generates values of lnA and 1/B, stored as the parameters NAME-lnA and NAME-1dB, either as constant variables or with assigned uncertainties.

FRACTILE-95-99	The Weibull distribution is fitted to two fractiles in the Sum-Rayleigh distribution, calculated at the 95% and 99% cumulative probabilities. This generates a deterministic fit, with constant values of lnA and 1/B.
DETERMINISTIC	The Weibull distribution is fitted to any number of fractiles in the Sum-Rayleigh distribution, as specified by the user in the command DEFINE WEIBULL-FIT DETERMINISTIC. This generates a deterministic fit, with constant values of lnA and 1/B.
PROBABILISTIC	The Weibull distribution is fitted to three fractiles in the Sum-Rayleigh distribution, as specified by the user in the command DEFINE WEIBULL-FIT PROBABILISTIC. This generates a probabilistic fit, with uncertainties assigned to NAME-lnA and/or NAME-1/B, and with a possible correlation between the two.

NOTES:

1 To change the uncertainty of a parameter, use the command ASSIGN UNCERTAINTY VALUE.

2 The uncertainty applied in the probabilistic fit is described in chapter 3. See also the command ASSIGN MODEL-FACTOR.

3 The bivariate distribution type fitted to each scatter diagram (if any) is defined by use of ASSIGN WAVE-SCATTER-DISTRIBUTION.

4 The stress range assignment can be printed by use of the command PRINT FATIGUE-POINT or PRINT INSPECTION.

See also:

- ASSIGN SCF
- ASSIGN INFLUENCE-COEFFICIENTS
- ASSIGN MODEL-FACTOR
- CREATE TRANSFER-FUNCTION
- ASSIGN TRANSFER-FUNCTION
- CREATE WAVE-STATISTICS
- ASSIGN WAVE-SCATTER-DISTRIBUTION
- ASSIGN-WAVE-SPECTRUM-SHAPE
- CREATE WAVE-SPREADING-FUNCTION
- ASSIGN WAVE-SPREADING-FUNCTION
- ASSIGN WAVE-DIRECTION-PROBABILITY
- ASSIGN WAVE-STATISTICS

- PRINT FATIGUE-POINT
- PRINT INSPECTION

EXAMPLES:

```
ASSIGN STRESS-RANGE FATIGUE-POINT C3501 CONSTANT 40.0 0.15
ASSIGN STRESS-RANGE FATIGUE-POINT WEIBULL-AB 4.2 0.8 0.15
ASSIGN STRESS-RANGE FATIGUE-POINT WEIBULL-FIT PROBABILISTIC
```

ASSIGN TARGET-RELIABILITY

...	TARGET-RELIABILITY	fatigpnt+	LIFETIME-RELIABILITY	beta
			LIFETIME-PROBABILITY	prob
			ANNUAL-RELIABILITY	beta
			ANNUAL-PROBABILITY	prob

PURPOSE:

Assign the target reliability at which an inspection is required to a fatigue point.

PARAMETERS:

fatigpnt+	A selection of names of fatigue points.
LIFETIME-RELIABILITY	Target is lifetime reliability.
LIFETIME-PROBABILITY	Target is lifetime probability.
ANNUAL-RELIABILITY	Target is annual reliability.
ANNUAL-PROBABILITY	Target is annual probability.
beta	The target reliability.
prob	The target probability.

NOTES:

1 The target reliability is used to set up an inspection plan.

2 The target reliability assignment can be printed by use of the command PRINT FATIGUE-POINT.

See also:

- PRINT FATIGUE-POINT
- ASSIGN INSPECTION-QUALITY
- RUN PLAN-INSPECTION

EXAMPLES:

```
ASSIGN TARGET-RELIABILITY C35* ANNUAL-PROBABILITY 0.0001
ASSIGN TARGET-RELIABILITY C3501 LIFETIME-RELIABILITY 2.5
```

ASSIGN THICKNESS-CORRECTION

...	THICKNESS-CORRECTION	name	NONE	
			STANDARD-T-CURVE	tref
			ARBITRARY	tref, tcut, texp

PURPOSE:

To assign thickness correction to an SN-curve.

PARAMETERS:

name	SN-curve name.
NONE	No thickness correction applies.
STANDARD-T-CURVE	Standard T-curve (tcut=tref, texp=0.25). The reference thickness may e.g. be 0.032 metres, but must be given in current consistent units.
ARBITRARY	User specifies all the parameters used in the thickness correction formula.
tref	Reference thickness, for which the SN-curve is valid without correction.
tcut	Cut-off thickness. If the actual thickness is smaller, the cut-off thickness is applied in the formula below.
texp	Exponent.

NOTES:

1 SN-curves have no thickness correction assigned at creation.

2 The thickness correction assignment can be printed by use of the command PRINT SN-CURVE

3 The thickness correction factor *f* to be applied to the hotspot stress is computed according to the following formula for a given section thickness *t*:

$$f = \begin{cases} (t_{cut}/t_{ref})^{t\exp} & (t \le t_{cut}) \\ (t/t_{ref})^{t\exp} & (t > t_{cut}) \end{cases}$$

4 The following figure illustrates the application of the thickness correction.

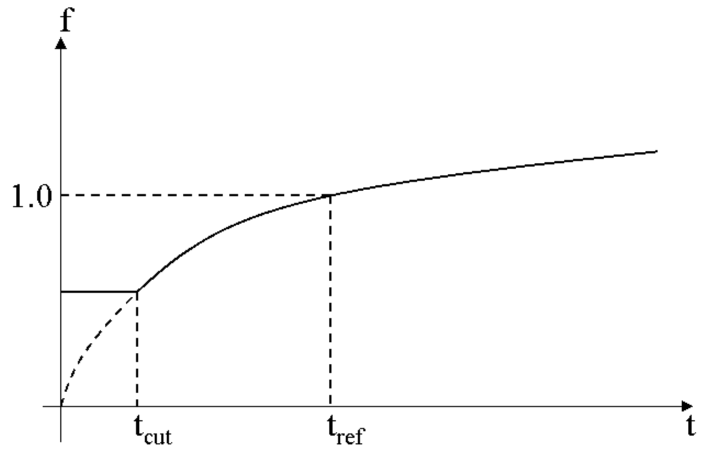


Figure 5.1 Application of thickness correction to an SN-curve

See also:

- CREATE SN-CURVE

EXAMPLES:

```
ASSIGN THICKNESS-CORRECTION DNV-T STANDARD-T-CURVE 0.032
```

ASSIGN TRANSFER-FUNCTION

<table>
<tr><td rowspan="4">...</td><td rowspan="4">TRANSFER-FUNCTION</td><td rowspan="4">fatigpnt/inspect</td><td colspan="3">NONE</td></tr>
<tr><td>WAVE-HEIGHT</td><td colspan="2">TRFs</td></tr>
<tr><td rowspan="2">STOCHASTIC</td><td rowspan="2">HS, TZ</td><td>TRFs</td></tr>
<tr><td>NONE</td></tr>
</table>

PURPOSE:

Assign force transfer functions to a fatigue point or an inspection with a repair assigned.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection with a repair assigned. This is referred to as NAME in the naming of stochastic parameters below.
NONE	No transfer functions are assigned.
WAVE-HEIGHT	Wave height linearisation has been used
STOCHASTIC	Stochastic linearisation has been used
HS, TZ	Values at which the stochastic linearisation has been performed. More than one Hs,Tz combination can be specified, and will then be applied in the calculation of the Sum-Rayleigh distribution for the stress range.
NONE	Disable any previous transfer function assignment to the fatigue point for this Hs,Tz combination.
TRFs	A number of transfer functions, specified by name. The number will be 3 if SCFs has been assigned to the fatigue point / inspection, or it will be the same as the number of influence coefficients, if influence coefficients has been assigned to the fatigue point / inspection. The order of the transfer functions must match the order of the SCFs or influence coefficients.

NOTES:

1 The transfer function assignment can be printed by use of the command PRINT FATIGUE-POINT.

2 Note that the stress range assigned to the fatigue point is not changed until an ASSIGN STRESS-RANGE command is issued.

See also:

- CREATE TRANSFER-FUNCTION
- CHANGE TRANSFER-FUNCTION

- DISPLAY-TRANSFER-FUNCTION
- PRINT TRANSFER-FUNCTION
- ASSIGN SCF
- ASSIGN INFLUENCE-COEFFICIENTS
- PRINT FATIGUE-POINT

EXAMPLES:

```
ASSIGN TRANSFER-FUNCTION FATIGUE-POINT C3105 WAVE-HEIGHT T3105XX T3105XZ T3105YZ
```

ASSIGN UNCERTAINTY VALUE

<table>
<tr><td rowspan="8">...</td><td rowspan="8">VALUE</td><td rowspan="8">parameter+</td><td colspan="2">NONE</td></tr>
<tr><td colspan="2">LOW</td></tr>
<tr><td colspan="2">MEDIUM</td></tr>
<tr><td colspan="2">HIGH</td></tr>
<tr><td>COV</td><td>cov</td></tr>
<tr><td>STDV</td><td>stdv</td></tr>
<tr><td colspan="2">KNOWN</td></tr>
<tr><td>VARIABLE</td><td>name</td></tr>
</table>

PURPOSE:

Assign uncertainty value to a parameter.

PARAMETERS:

parameter+	The name of one or more parameters, that can have uncertainty assigned (See note 1 below). Such a parameter has its own name, if it is a global parameter (e.g. Service-Life), or a derived name if it belongs to a named object. The derived name is composed of the name of the object (e.g. MEMB3501) and an identification of the parameter (e.g. Width), connected by a hyphen (e.g. MEMB3501-Width). The uncertainty representation is stored in a variable with the same name as the parameter, but truncated to 12 characters (e.g. MEMB3501-Wid) (See note 2 below).
NONE	The parameter has no uncertainty assigned, i.e. the associated variable is FIXED.
LOW	The parameter has a low uncertainty assigned (see note 3 below).
MEDIUM	The parameter has a medium uncertainty assigned (see note 3 below).
HIGH	The parameter has a high uncertainty assigned (see note 3 below).
COV	The uncertainty of the parameter is specified as a coefficient of variation (see note 3 below).
cov	The coefficient of variation ((Standard Deviation) = (Coef of Var) * Abs(Mean)).
STDV	The uncertainty of the parameter is specified as a standard deviation (see note 3 below).
stdv	The standard deviation.
KNOWN	The standard deviation is a function of the mean and cannot be specified directly.
VARIABLE	The uncertainty of the parameter is represented as another random variable.

name The name of a one dimensional random variable.

NOTES:

1 All parameters that can have uncertainty assigned are documented with the commands where they are being used.

2 The variable associated with the parameter can be examined using the commands PRINT VARIABLE, PRINT DISTRIBUTION and DISPLAY DISTRIBUTION.

3 Each parameter type (e.g. the width of the of the plate in which the fatigue point sits) has a default uncertainty definition. This definition consists of a random distribution (e.g. Normal), and definition of LOW, MEDIUM and HIGH uncertainty in terms of standard deviation and/or coefficient of variation (when both of these are specified, the one that generates the highest standard deviation for a given mean value takes effect). The mean value of the variable will be the input value of the parameter. This definition may be changed by use of the command DEFINE UNCERTAINTY. All available parameter types can be printed by use of the command PRINT UNCERTAINTY DEFINITION OVERVIEW. The default distribution and uncertainty can be printed by use of PRINT UNCERTAINTY DEFINITION DESCRIPTION.

4 To bypass the default distribution, use the VARIABLE option.

5 In some cases (e.g. the Exponential distribution), the standard deviation is a function of the mean value and cannot be specified directly. In such a case, only the NONE, KNOWN and VARIABLE alternatives will be presented.

6 The VARIABLE option may be used to assign the same random variable to several parameters, for example, to use the same material parameter at two hotspots on the same member:

```
CREATE VARIABLE lnC ' ' DISTRIBUTION NORMAL M-C -31 0.1
ASSIGN UNCERTAINTY VALUE C3501A-lnC VARIABLE lnC
ASSIGN UNCERTAINTY VALUE C3501B-lnC VARIABLE lnC
```

7 The current uncertainty assignment may be printed by use of the command PRINT UNCERTAINTY VALUE.

8 Uncertain parameters can be correlated by use of the command ASSIGN CORRELATION with the associated variable.

9 If a selection of more than one parameter names is made, the remaining input will be presented as the current safety level specification of all the selected parameters. If not all selected parameters have the same specification, there will be no default value for the remaining parameters.

See also:

- ASSIGN CORRELATION
- CREATE VARIABLE
- DEFINE UNCERTAINTY
- DISPLAY DISTRIBUTION
- PRINT DISTRIBUTION

- PRINT UNCERTAINTY
- PRINT VARIABLE

EXAMPLES:

```
ASSIGN UNCERTAINTY VALUE C3501-lnA MEDIUM
ASSIGN UNCERTAINTY VALUE C35*-1dB HIGH
```

ASSIGN WAVE-DIRECTION-PROBABILITY

...	WAVE-DIRECTION-PROBABILITY	wave-dir	probability

PURPOSE:

To assign a probability associated with a wave direction.

PARAMETERS:

wave-dir	Wave direction in degrees.
probability	Probability associated with wave direction.

NOTES:

1 The initial value of all wave direction probabilities are 0.0.

2 The sum of wave direction probabilities must be 1.0.

See also:

- PRINT WAVE-DIRECTIONS

EXAMPLES:

```
ASSIGN WAVE-DIRECTION-PROBABILITY 0 1.0
```

ASSIGN WAVE-SCATTER-DISTRIBUTION

...	WAVE-SCATTER-DISTRIBUTION	stat-name	NONE
			LOGNORMAL
			FANG-HOGBEN

PURPOSE:

To assign a distribution fit to the wave scatter diagram during calculation of the Sum-Rayleigh long term stress distribution.

PARAMETERS:

stat-name Name of wave statistics (scatter diagram).

NONE The input scatter diagram is used directly.

LOGNORMAL A bivariate lognormal distribution is fitted to the (H_S,T_Z) data.

FANG-HOGBEN For a distribution described by Fang and Hogben to describe the (H_S,T_Z) data.

NOTES:

The calculation of the Sum-Rayleigh long term stress distribution.is described in more detail in the Profast Theory Manual.

See also:

- CREATE WAVE-STATISTICE
- PRINT WAVE-STATISTICS
- ASSIGN WAVE-STATISTICS
- ASSIGN STRESS-RANGE
- ASSIGN MODEL-FACTOR SCATTER-DISTRIBUTION

EXAMPLES:

The default assignment is the Lognormal distribution:

```
ASSIGN WAVE-SCATTER-DISTRIBUTION scatter LOGNORMAL
```

ASSIGN WAVE-SPECTRUM-SHAPE

<table>
<tr><td rowspan="3">...</td><td rowspan="3">WAVE-SPECTRUM-SHAPE</td><td rowspan="3">stat-name</td><td colspan="2">PIERSON-MOSKOWITZ</td><td rowspan="3">...</td></tr>
<tr><td>JONSWAP</td><td>gamma, sigmaA, sigmaB</td></tr>
<tr><td>GENERAL-GAMMA</td><td>facL, facN</td></tr>
</table>

<table>
<tr><td rowspan="2">...</td><td colspan="2">ALL</td></tr>
<tr><td>PART</td><td>lowHs , uppHs, lowTz , uppTz</td></tr>
</table>

PURPOSE:

To assign a wave spectrum shape to a wave statistics (scatter diagram).

PARAMETERS:

stat-name	Name of wave statistics (scatter diagram).
PIERSON-MOSKOWITZ	A Pierson-Moskowitz spectrum shall be assigned to the wave statistics.
JONSWAP	A JONSWAP spectrum shape shall be assigned to the wave statistics.
gamma	Peak enhancement factor of JONSWAP.
sigmaA	Left width of JONSWAP spectrum.
sigmaB	Right width of JONSWAP spectrum.
GENERAL-GAMMA	A GENERAL-GAMMA spectrum shape shall be assigned to the wave-statistics.
facL	Parameter L for the GENERAL-GAMMA spectrum.
facN	Parameter N for the GENERAL-GAMMA spectrum.
ALL	The spectrum shape is assigned to all sea states in the wave-statistics.
PART	The spectrum shape is assigned to a subset of the wave-statistics, where [H_S, T_Z] is between specified limits.
lowH_S	Lowest H_S-value.
uppH_S	Upper H_S-value.
lowT_Z	Lowest T_Z-value.

$uppT_z$	Upper T_z-value.

NOTES:

Please be aware that the Jonswap spectrum is much more time consuming than the Pierson Moskowitz spectrum.

See also:

- CREATE WAVE-STATISTICE
- PRINT WAVE-STATISTICS
- ASSIGN WAVE-SPREADING-FUNCTION
- ASSIGN MODEL-FACTOR WAVE-SPECTRUM-SHAPE

EXAMPLES:

```
ASSIGN WAVE-SPECTRUM-SHAPE SCATTERA JONSWAP 3.3 0.07 0.09 ALL
```

ASSIGN WAVE-SPREADING-FUNCTION

...	WAVE-SPREADING-FUNCTION	stat-name	spread-name	...
			NONE	

...	ALL	
	PART	lowHs, uppHs, lowTz , uppTz

PURPOSE:

To assign a spreading function to a wave statistics (scatter diagram).

PARAMETERS:

stat-name	Name of wave statistics (scatter diagram) to be assigned the spreading function.
spread-name	Name of spreading function to be assigned to stat-name.
NONE	No spreading is assigned, the sea is assumed to be long crested.
ALL	The spreading function is assigned to all sea states in the wave-statistics.
PART	The spreading function is assigned to a subset of the wave-statistics, where [H_S, T_Z] is between specified limits.
lowH_S	Lowest H_S-value.
uppH_S	Upper H_S-value.
lowT_Z	Lowest T_Z-value.
uppT_Z	Upper T_Z-value.

NOTES:

See also:

- CREATE WAVE-STATISTICS
- CREATE WAVE-SPREADING-FUNCTION
- PRINT WAVE-SPREADING-FUNCTION
- ASSIGN MODEL-FACTOR WAVE-SPREADING

EXAMPLES:

```
ASSIGN WAVE-SPREADING-FUNCTION SCATTERA SPREDA ALL
```

ASSIGN WAVE-STATISTICS

...	WAVE-STATISTICS	wave-dir	stat-name

PURPOSE:

To assign a wave statistics (scatter diagram) to a wave direction.

PARAMETERS:

wave-dir	Wave direction.
stat-name	Name of wave statistics (scatter diagram) to be associated with the wave direction wave-dir.

NOTES:

See also:

- CREATE WAVE-STATISTICS

EXAMPLES:

```
ASSIGN WAVE-STATISTICS 0 SCATTERA
```

ASSIGN WELD-EFFECT

<table>
<tr><td rowspan="5">...</td><td rowspan="5">WELD-EFFECT</td><td rowspan="5">fatigpnt/inspect</td><td colspan="4">NONE</td></tr>
<tr><td>PD6493</td><td colspan="3">AttLen, MemStr</td></tr>
<tr><td colspan="4">KJOINT-FIT</td></tr>
<tr><td>GENERAL-DATA</td><td>{</td><td>d,Mgf</td><td>}*</td></tr>
<tr><td>NORMALISED-DATA</td><td>{</td><td>dt,Mgf</td><td>}*</td></tr>
</table>

PURPOSE:

To assign a weld effect to a fatigue point or an inspection with a repair assigned, thus multiplying a stress intensity factor to the geometry function.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection with a repair assigned. This is referred to as NAME in the naming of stochastic parameters below.
NONE	No weld effect is applied to this fatigue point.
PD6493	Use the weld effect specified in the British code PD6493.
AttLen	Length of attachment at weld. Uncertainty can be assigned to the parameter NAME-AtLen.
MemStr	Membrane-stress ratio. Note that this may also need to be specified when not already specified with ASSIGN GEOMETRY-FUNCTON. Uncertainty can be assigned to the parameter NAME-MSRatio.
KJOINT-FIT	Use the following stress intensity factor, derived from finite element analysis: 1.0 + 1.24*Exp(-22.1*(d/t)) + 3.17*Exp(-357*(d/t)) where d is the crack depth and t is the thickness.
GENERAL-DATA	The stress intensity factor is specified through a set of data points. This option may not be implemented.
d,Mgf*	A number of values of depths d and weld magnification factors Mgf, specifying the user defined stress intensity function. A simple spline will be fitted to the function.
NORMALISED-DATA	The stress intensity factor is specified through a set of normalised data points.
dt,Mgf*	A number of values of normalised depths dt (from 0 to 1) and weld magnification factors Mgf, specifying the user defined stress intensity function. A simple spline will be fitted to the function.

NOTES:

1 A weld effect cannot be applied to the PLATE-CENTER and PLATE-EDGE crack types.

2 To change the uncertainty of a parameter, use the command ASSIGN UNCERTAINTY VALUE.

3 If the model is assigned to an inspection, all stochastic parameters can be specified as “Unchanged” (this input is case insensitive, but cannot be abbreviated). In this case the value from the previous inspection (or the fatigue point if no previous inspection exist) is used unchanged.

4 The weld effect assignment can be displayed and printed by use of the commands DISPLAY WELD-EFFECT and PRINT FATIGUE-POINT.

See also:

- ASSIGN CRACK-GROWTH-MODEL
- ASSIGN GEOMETRY-FUNCTION
- DISPLAY WELD-EFFECT
- PRINT FATIGUE-POINT

EXAMPLES:

```
ASSIGN WELD-EFFECT FATIGUE-POINT C3501 NONE
ASSIGN WELD-EFFECT FATIGUE-POINT C3501 NORMALISED-DATA ( 0.0 1.0 0.3 2.5 0.6 3.4
1.0 2.5 )
```

CHANGE

CHANGE	EVENT	...
	FUNCTION	...
	SN-CURVE	...
	TRANSFER-FUNCTION	...
	VARIABLE	...
	WAVE-SPREADING-FUNCTION	...

PURPOSE:

Change a named object.

PARAMETERS:

EVENT	Change an event.
FUNCTION	Change a function.
SN-CURVE	Change an SN curve.
TRANSFER-FUNCTION	Change a transfer function.
VARIABLE	Change a random variable.
WAVE-SPREADING-FUNCTION	Change a wave spreading function.

NOTES:

None.

CHANGE EVENT

<table>
<tr><td rowspan="4">...</td><td rowspan="4">EVENT</td><td rowspan="4">name</td><td rowspan="4">desc</td><td>CONDITIONED</td><td>event</td><td colspan="2">condition</td></tr>
<tr><td>INTERSECTION</td><td colspan="3">subevent+</td></tr>
<tr><td>SINGLE</td><td>1d-variable</td><td><, =, ></td><td>threshold</td></tr>
<tr><td>UNION</td><td colspan="3">subevent+</td></tr>
</table>

PURPOSE:

To change an event

PARAMETERS:

name	Name of the event to be changed.
desc	Descriptive text for the event.
CONDITIONED	The event is a conditioned event.
event	The name of the event that is being conditioned.
condition	The name of the event that is forming the condition.
INTERSECTION	The event is an intersection of other events, i.e. it is fulfilled only when all subevents are fulfilled.
UNION	The event is a union of other events, i.e. it is fulfilled when at least one subevent is fulfilled.
subevent+	A selection of events forming either an intersection of union. These cannot be conditioned events.
SINGLE	The event is a simple (in)equality.
1d-variable	The name of the one dimensional variable that is forming the left hand side if the (in)equality.
(IN)EQ	The type of (in)equality. One of: <, =, >
threshold	The numerical right hand side of the single event.

NOTES:

1 When the event name is selected, the existing state of the event is presented as defaults (unless the type of the event is changed).

2 The events that are created by this program should not be changed by the user.

See also:

- CREATE EVENT
- COPY EVENT
- RENAME EVENT
- DISPLAY EVENT
- PRINT EVENT
- ASSIGN STARTING-POINT
- ASSIGN MEASURED-VALUE

EXAMPLES:

```
CHANGE EVENT Loss : NPV 0
CHANGE EVENT No1-Crack2 : INTERSECTION ( ONLY NoCrack-1 Crack2 )
CHANGE EVENT Fail-Cond 'Failure given nofind, then find' CONDITIONED Failure No1-
Crack2
```

CHANGE FUNCTION

...	FUNCTION	name	desc	FORMULA	...
				INTEGRAL	...
				RESPONSESURFACE	...

PURPOSE:

To change a function.

PARAMETERS:

name	Name of the function. Cannot be changed.
desc	Descriptive text associated with the function formula.
FORMULA	Change a function formula.
INTEGRAL	Change an integration function.
RESPONSESURFACE	Change a response surface function.

NOTES:

None.

CHANGE FUNCTION ... FORMULA

...	FORMULA	{	arguments	adesc	}*	formula-text

PURPOSE:

Change a function formula.

PARAMETERS:

argument	Name of a formula argument At least one argument must be defined.
adesc	Description of argument.
formula-text	Formula text lines.

NOTES:

Formula syntax is described in command CREATE FUNCTION FORMULA.

See also:

- CREATE FUNCTION ... FORMULA
- DELETE FUNCTION ... FORMULA
- DISPLAY FUCTION
- PRINT FUNCTION
- RENAME FUNCTION

EXAMPLES:

```
CHANGE FUNCTION FORMULA SYMFOR1 'Symbolic Formula' ( ONLY A 'Arg 1' B 'Arg 2' )
'(A+B)**2'
CHANGE FUNCTION FORMULA SYMFOR2 'Symbolic Formula' ( 'A+FUNOPT ( OPT_NAM_1 =
''Quot''''-1'', OPT_NAM_2=file.name, OPT_NAM_3=MENU_ENTRY, OPT_NAM_4 = 3,
OPT_NAM_5 = 0.5E-3,B*3-A)' )
```

CHANGE FUNCTION ... INTEGRAL

...	INTEGRAL	{	argname	argdesc	}*	function	{	value integrator	}*	...

...	method	lowerbound	upperbound	tolerance

PURPOSE:

To change an integration function.

PARAMETERS:

argname, argdesc	Matrix of argument names and corresponding argument descriptions. At least one argument must be defined.
function	Name of function to be integrated (integrand).
value	Value can be a numerical value or an argument name, “argname”.
integrator	Text value: integrator. Case insensitive. The text value “integrator” is inserted in order to identify the single integration variable.
method	Integration method to be used. One of: ROMBERG, SIMPSON or TRAPEZOIDAL.
lowerbound	Lower bound for integrator. Must be a numerical value or an argument name, “argname”.
upperbound	Upper bound for integrator. Must be a numerical value or an argument name, “argname”.
tolerance	Relative precision in result of integration.

NOTES:

1 An argument name consists of maximum 12 alphanumeric characters and _. The first character must be alphabetic.

2 An argument description consists of maximum 50 characters.

3 The text value “integrator” may be an attribute of more than one function parameter.

See also:

- CREATE FUNCTION ... INTEGRAL
- DISPLAY FUNCTION

- PRINT FUNCTION
- RENAME FUNCTION

EXAMPLES:

Change integration of c+x from x=a to x=b to c+c+a+b+x+x from x=a to x=b

```
CHANGE FUNCTION cplusx 'Integrate c+c+a+b+x+x from x=a to x=b' INTEGRAL ( ONLY a
'x_lower' b 'x_upper' c 'additive parameter' ) Sum ( ONLY c c a b Integrator In-
tegrator ) Romberg a b 0.000001
```

CHANGE FUNCTION ... RESPONSESURFACE

...	RESPONSESURFACE	{	argname	argdesc	}*	function	...

...	{	point,argname,method,increment	}*

PURPOSE:

To change a response surface function.

PARAMETERS:

argname, argdesc	Matrix of argument names and corresponding argument descriptions. At least one argument must be defined.
function	Name of function to be approximated.
point	Centre of approximations
argname	Argument name. This approximated function argument becomes the argument argname of the approximation.
method	Function fit method to be used. L or L1: Linear approximation based on positive incrementation. L2 : Linear approximation based on two way incrementation. D : Quadratic (diagonal) approximation. No cross derivatives with other arguments. QName :Q followed by name. Quadratic approximation including cross terms for arguments that have the same group Name. Q alone is treated as a group.
increment	Increment to be used with the fit.

NOTES:

1 An argument name consists of maximum 12 alphanumeric characters and _. The first character must be alphabetic.

2 An argument description consists of maximum 50 characters.

3 Point,argname,method and increment are comma separated.

See also:

- CREATE FUNCTION ... RESPONSESURFACE
- DISPLAY FUNCTION

- PRINT FUNCTION
- PRINT RESPONSESURFACE
- RENAME FUNCTION

EXAMPLES:

Change a quadratic response surface function to appfunc centred around (1,2,3), with increment 1 for the second argument of appfunc and increment 2 for the third argument of appfunc including cross terms. The response function has two arguments, while the approximated function has three arguments:

```
CHANGE FUNCTION rspfu 'Response surface' RESPONSESURFACE ( ONLY a 'x_arg1' b
'x_arg2' ) appfunc 1 2,a,QGroup,1 3,b,QGroup,2
```

Change linear response surface function to appfunc centred around (1,2,3), with increment 1 for each argument. the second argument of appfunc and increment 2 for the third argument of appfunc including cross terms:

```
CHANGE FUNCTION rspfu 'Response surface' RESPONSESURFACE ( ONLY a 'x_arg1' b
'x_arg2' c 'x_arg3' ) appfunc 1,c,L,1 2,b,L1,1 3,a,L2,1
```

CHANGE SN-CURVE

...	SN-CURVE	name	USER	data
			LOGA	data
			STOCHASTIC	data
			UNCERTAINTY	std(logk0)

PURPOSE:

Change the properties of an SN curve.

PARAMETERS:

sn-name	Name of SN-curve to be changed.
USER	The SN curve is specified using the stress level S.
LOGA	The SN curve is specified defined using the value of loga (sometimes named logk), usually incorporating a safety factor.
STOCHASTIC	The SN curve is specified with parameters that can be stochastic.
data	See CREATE SN-CURVE.
UNCERTAINTY	Change the uncertainty of log10(k0).
std(logk0)	The standard deviation of $\log_{10}$(k0).

NOTES:

See also:

- ASSIGN SN-CURVE
- CREATE SN-CURVE
- DISPLAY SN-CURVE
- PRINT SN-CURVE

EXAMPLES:

```
CHANGE SN-CURVE DNVX USER 'Veritas X-curve' 4.1 34 8.29 HORISONTAL TAIL
CHANGE SN-CURVE DNVX UNCERTAINTY 0.4
```

CHANGE TRANSFER-FUNCTION

...	TRANSFER-FUNCTION	name	desc	dir	freq, real, imag*

PURPOSE:

Change a transfer function.

PARAMETERS:

name	Name of transfer function to be changed.
desc	A descriptive text for the transfer function.
dir	Wave direction in degrees.
freq, real, imag*	Transfer function data in sets of (frequency, real part, imaginary part).

NOTES:

See also:

- ASSIGN TRANSFER-FUNCTION
- CREATE TRANSFER-FUNCTION
- DISPLAY TRANSFER-FUNCTION
- PRINT TRANSFER-FUNCTION

EXAMPLES:

```
CHANGE TRANSFER-FUNCTION TRF33 'Descriptive text' 45 ( ONLY 0.503 18.14 31.62 1.257
14.93 14.08 2.094 20.54 27.81 3.142 -8.02 37.97 )
```

CHANGE VARIABLE

...	VARIABLE	name	disc	DISTRIBUTION	...
				FITTED-DISTRIBUTION	...
				FIXED	value
				FUNCTION	...
				GENERATED	1dvar
				IDENTITY	variable

PURPOSE:

To change a variable.

PARAMETERS:

name	Name of the variable to be changed.
disc	Descriptive text for the variable.
DISTRIBUTION	The variable is assigned a distribution. See a following page for details.
FITTED-DISTRIBUTION	The variable is assigned a distribution that is fitted to input data. See a following page for details.
FIXED	The variable has a fixed value.
value	The numerical value of a fixed variable.
FUNCTION	The variable is assigned a model function. See a following page for details.
GENERATED	The distribution of the variable is generated from the distribution of another variable.
1dvar	The variable specifying a generated distribution. This is a one-dimensional variable or a coordinate in a multidimensional variable.
IDENTITY	The variable is identical to another variable.
variable	The name of an existing variable.

NOTES:

1 When the variable name is selected, the existing state of the variable is presented as defaults (unless the type of the variable is changed).

2 Some of the variables in a generated distribution may be shared between the generated variable and the generating variable by using the ASSIGN CONDITIONING command.

3 A generated distribution may be assigned an extreme type distribution by using the ASSIGN EXTREME-VALUE command.

See also:

- CREATE VARIABLE
- COPY VARIABLE
- RENAME VARIABLE
- PRINT VARIABLE
- ASSIGN CONDITIONING
- ASSIGN EXTREME-VALUE

EXAMPLES:

```
CHANGE VARIABLE Width : FIXED 22.5
CHANGE VARIABLE Amplitude : GENERATED Var44
```

CHANGE VARIABLE ... DISTRIBUTION

<table>
<tr><td rowspan="2">...</td><td rowspan="2">DISTRIBUTION</td><td>distribution</td><td>[dim]</td><td>input-seq</td><td>parameters</td></tr>
<tr><td>SPLINE-1DIM</td><td colspan="3">...</td></tr>
</table>

PURPOSE:

To change a variable to be based on a distribution, or to change a distribution already assigned.

PARAMETERS:

distribution	The name of the distribution (excepting the spline distribution).
[dim]	The dimension of the distribution, if this is not fixed.
input-seq	The sequence of parameters used to define the distributions.
parameters	The parameter value(s) for the chosen input sequence. Each parameter value may be either a numerical value or the name of an existing one-dimensional variable. Please note that the name of a variable cannot be abbreviated here.
SPLINE-1DIM	The variable is assigned a distribution, fitted to input data. See a following page for details.

NOTES:

1 The existing values are presented as defaults whenever this is possible.

2 The variable may be assigned an extreme type distribution by using the ASSIGN EXTREME-VALUE command.

3 The distribution function and density values may be printed by use of the PRINT DISTRIBUTION command.

4 The moments of the distribution are calculated and printed (if possible) by use of the PRINT VARIABLE command.

5 The distributions are described in SESAM User's Manual: Proban Distribution.

See also:

- CREATE VARIABLE
- DISPLAY DISTRIBUTION
- PRINT VARIABLE
- PRINT DISTRIBUTION

- ASSIGN EXTREME-VALUE

EXAMPLES:

```
CHANGE VARIABLE X ' ' DISTRIBUTION Normal Mean-CoV 22 0.2
CHANGE VARIABLE Y ' ' DISTRIBUTION Normal Mean-Std X 3.1
```

CHANGE VARIABLE ... DISTRIBUTION SPLINE-1DIM

<table>
<tr><td rowspan="2">...</td><td rowspan="2">SPLINE-1DIM</td><td rowspan="2">lower</td><td rowspan="2">upper</td><td>UNWEIGHTED</td><td>{</td><td>fractile</td><td>probability</td><td colspan="2">}*</td><td rowspan="2">...</td></tr>
<tr><td>WEIGHTED</td><td>{</td><td>fractile</td><td>probability</td><td>weight</td><td>}*</td></tr>
</table>

<table>
<tr><td rowspan="4">...</td><td>HIGH</td><td rowspan="4">...</td><td rowspan="3">FREE</td><td>EQUAL</td></tr>
<tr><td>MEDIUM</td><td>FREE</td></tr>
<tr><td rowspan="2">LOW</td><td>VANISH</td></tr>
<tr><td colspan="2">UNIMODAL</td></tr>
</table>

PURPOSE:

To change a variable to have a fitted distribution based on splines, or to change a spline distribution already assigned.

PARAMETERS:

lower	The lower bound of the distribution.
upper	The upper bound of the distribution.
UNWEIGHTED	Do not apply user defined weights to the spline fit.
WEIGHTED	Apply user defined weights to the input points in the spline fit.
fractile, probability	The fractiles and probability values to which the distribution function is fitted. All probabilities must be greater than 0 and smaller than 1.
fractile, probability, weighted	The fractiles and probability values to which the distribution function is fitted with corresponding weights. All probabilities must be greater than 0 and smaller than 1.
HIGH	Use high accuracy when fitting the spline distribution to the data. In some cases it may be difficult to get convergence when high accuracy is used.
MEDIUM	Use medium accuracy when fitting the spline distribution to the data.
LOW	Use low accuracy when fitting the spline distribution to the data.
FREE	The fitted distribution need not be unimodal.
UNIMODAL	The fitted distribution must be unimodal.
EQUAL	The tail values of a FREE fit must be identical.

FREE	No restriction on the tail values of a FREE fit, except that they are non-negative.
VANISH	Both tail values of a FREE fit must be zero.

NOTES:

1 The existing values are presented as defaults whenever this is possible. If changing from UNWEIGHTED to WEIGHTED, the existing fractiles and probabilities are kept as defaults, and the weights are all set to 1.

2 If the spline will not fit, try relaxing the demands on accuracy or check if any of the points have been specified wrongly.

3 The variable may be assigned an extreme type distribution by using the ASSIGN EXTREME-VALUE command.

4 The distribution function and density values may be printed by use of the PRINT DISTRIBUTION command.

5 The moments of the distribution are calculated and printed (if possible) by use of the PRINT VARIABLE command.

6 The distribution itself may be displayed using DISPLAY DISTRIBUTION. The accuracy of the fit may be examined using DISPLAY FITTED-DISTRIBUTION.

See also:

- CREATE VARIABLE
- DISPLAY DISTRIBUTION
- DISPLAY FITTED-DISTRIBUTION
- PRINT VARIABLE
- PRINT DISTRIBUTION
- ASSIGN EXTREME-VALUE

EXAMPLES:

```
CHANGE VARIABLE X ' ' DISTRIBUTION Spline-1Dim 0 10 UNWEIGHTED ( ONLY 1.0 0.5 3.0
0.25 5.0 0.5 7.0 0.7 8.0 0.9 9.0 0.95 ) HIGH UNIMODAL
```

CHANGE VARIABLE ... FITTED-DISTRIBUTION

...	FITTED-DISTRIBUTION	distribution	input-seq	parameter*	...

...	CUMULATIVE	WEIGHTED	{	Fractile	Probability	Weight	}*
		UNWEIGHTED	{	Fractile	Probability	}*	
	OBSERVATIONS	WEIGHTED	{	Observation	Weight	}*	
		UNWEIGHTED		Observation	*		
	RESULT	result name					

PURPOSE:

To change a variable to be fitted to a distribution, or to change a fitted distribution already assigned.

PARAMETERS:

distribution	The name of the distribution (excepting the spline distribution and multidimensional distributions).
input-seq	The sequence of parameters used to define the distributions.
parameter*	The parameter specification for the chosen input sequence. Each parameter value may be either specified as a numerical value (in which case it is not fitted), as: FIT, in which case it is fitted, or as: FIT<value>, where <value> is a numerical value used as starting point for an iterative fit. A lower bound on the fitted value is specified by L<value>. An upper bound on the fitted value is specified by U<value>.
CUMULATIVE	Fit to cumulative input data.
WEIGHTED	The input data are weighted. The weights must be positive.
UNWEIGHTED	The input data are not weighted.
Fractile, Probability, Weight	Successive values of fractiles, cumulative probabilities and weights. The probabilities must be in the interval]0,1[. The input data will be sorted in order of increasing probability.
Fractile, Probability	Successive values of fractiles and cumulative probabilities. The probabilities must be in the interval]0,1[. The input data will be sorted in order of increasing probability.
OBSERVATIONS	The input data are observed values of the variable.
Observation, Weight	Successive values of observations and weights. The input data will be sorted in order of increasing observation values.

Observation	Observed values of the random variable to which a distribution is fitted. The input data will be sorted in order of increasing observation values.
RESULT	Fit the distribution to the results of a probability or distribution analysis. Simulation results will be fitted and stored as OBSERVATIONS, after being grouped into weighted interval data if many samples exist. Mean value based FORM results will be fitted and stored as CUMULATIVE data with equal weights on all points. Probability results from a parameter study will be fitted (if possible) and stored as CUMULATIVE data with equal weights on all points. In the case of a parameter study of a distribution analysis, the result for the first parameter value is used.
result name	The name of the result for which the distribution is to be fitted.

NOTES:

1 The existing values are presented as defaults whenever this is possible.

2 The RESULT option can be useful for substituting a variable requiring lengthy computation time with a fitted distribution.

3 The variable may be assigned an extreme type distribution by using the ASSIGN EXTREME-VALUE command.

4 The distribution function and density values may be printed by use of the PRINT DISTRIBUTION command.

5 The moments of the distribution are calculated and printed (if possible) by use of the PRINT VARIABLE command.

6 The distribution itself may be displayed using DISPLAY DISTRIBUTION. The accuracy of the fit may be examined using DISPLAY FITTED-DISTRIBUTION.

7 The distributions are described in SESAM User's Manual: Proban Distributions.

See also:

- CREATE VARIABLE
- DISPLAY DISTRIBUTION
- DISPLAY FITTED-DISTRIBUTION
- PRINT VARIABLE
- PRINT DISTRIBUTION
- ASSIGN EXTREME-VALUE

EXAMPLES:

```
CHANGE VARIABLE X ' ' FITTED-DISTRIBUTION Normal Mean-CoV FIT FIT OBS UNW ( ONLY
1.34 2.56 8.65 4.32 4.67 6.66 5.23 3.25 )
CHANGE VARIABLE Y ' ' FITTED-DISTRIBUTION Normal Mean-Std FIT15 FIT CUMULATIVE
WEIGHTED ( ONLY 12 0.1 1 15 0.3 2 17 0.7 1 20 0.9 1 )
CREATE VARIABLE RES ' ' FITTED-DISTRIBUTION Lognormal Mean-Std-L FIT FIT 0 RESULT
LastAnalysis
```

CHANGE VARIABLE ... FUNCTION

...	FUNCTION	function	[dim]	arguments

PURPOSE:

To change a variable to be based on a model function, or to change a function already assigned.

PARAMETERS:

function	The name of the function. The functions can be listed by use of the commands PRINT FUNCTION LIBRARY and PRINT FUNCTION DESCRIPTION.
[dim]	The dimension of the function, if this is not fixed.
arguments	The argument value(s) for the chosen function. Each argument value may be either a numerical value or the name of an existing one-dimensional variable. Please note that the name of a variable cannot be abbreviated here.

NOTES:

1 The existing values are presented as defaults whenever this is possible.

2 The variables that are created by this program should not be changed by the user.

3 The selection of functions presented is determined by the current selection of sub-libraries (see SELECT FUNCTION-LIBRARY). This is because some libraries may contain a large number of functions and/or not be relevant to the current problem.

See also:

- CREATE VARIABLE
- PRINT VARIABLE
- PRINT FUNCTION
- SELECT FUNCTION-LIBRARY

EXAMPLES:

```
CHANGE VARIABLE Total-Durati : FUNCTION Sum ( EXCLUDE Path-1 )
CHANGE VARIABLE Diff1 ' ' FUNCTION Difference Resist5 Load4
```

CHANGE WAVE-SPREADING-FUNCTION

<table>
<tr><td rowspan="2">...</td><td rowspan="2">WAVE-SPREADING-FUNCTION</td><td rowspan="2">name</td><td rowspan="2">desc</td><td>COSINE-POWER</td><td colspan="3">power</td></tr>
<tr><td>USER-DEFINED</td><td>{</td><td>wave-dir, weight</td><td>}*</td></tr>
</table>

PURPOSE:

To modify a wave spreading function.

PARAMETERS:

name	Name of wave spreading function.
desc	Text associated with the spreading function.
COSINE-POWER	The spreading function is represented by a cosine function.
power	Power of the cosine function.
USER-DEFINED	The spreading function is defined by data points.
wave-dir, weight*	A set of points defining the spreading function: - Wave direction, relative to the main wave direction. - Weight associated with wave direction.

NOTES:

The sum of weights must be 1.0.

See also:

- ASSIGN WAVE-SPREADING-FUNCTION
- CREATE WAVE-SPREADING-FUNCTION
- DISPLAY WAVE-SPREADING-FUNCTION
- PRINT WAVE-SPREADING-FUNCTION
- ASSIGN MODEL-FACTOR WAVE-SPREADING

EXAMPLES:

```
CHANGE WAVE-SPREADING-FUNCTION COS2 'Analytical cos**2' COSINE 2
```

COPY

COPY	EVENT	...
	VARIABLE	...

PURPOSE:

Copy a named object to another.

PARAMETERS:

EVENT	Copy an event.
VARIABLE	Copy a random variable.

NOTES:

None.

COPY EVENT

...	EVENT	from	to

PURPOSE:

To copy one event to another.

PARAMETERS:

from	The name of the event to be copied.
to	The name of the new event. This cannot be the name of an existing event.

NOTES:

Only the basic contents of the event (i.e. those defined in CREATE) are copied. Assignments are not copied.

See also:

- CHANGE EVENT
- CREATE EVENT
- DELETE EVENT
- RENAME EVENT
- PRINT EVENT
- DISPLAY EVENT
- ASSIGN MEASURED-VALUE
- ASSIGN STARTING-POINT

EXAMPLES:

```
COPY EVENT Moment-1 Moment-2
```

COPY VARIABLE

...	VARIABLE	from	to

PURPOSE:

To copy one variable to another.

PARAMETERS:

from	The name of the variable to be copied.
to	The name of the new variable. This cannot be the name of an existing variable.

NOTES:

Only the basic contents of the event (i.e. those defined in CREATE) are copied. Assignments are not copied.

See also:

- CHANGE VARIABLE
- CREATE VARIABLE
- DELETE VARIABLE
- RENAME VARIABLE
- PRINT VARIABLE
- DISPLAY VARIABLE
- ASSIGN CONDITIONING
- ASSIGN CORRELATION
- ASSIGN EXTREME-VALUE
- ASSIGN FUNCTION-OPTION
- ASSIGN OPTIMISATION-BOUNDS
- ASSIGN SENSITIVITY-CALCULATION
- ASSIGN STARTING-POINT

EXAMPLES:

```
COPY VARIABLE Width1 Width2
```

CREATE

CREATE	EVENT	...
	FATIGUE-POINT	...
	FUNCTION	...
	INSPECTION	...
	SN-CURVE	...
	TRANSFER-FUNCTION	...
	VARIABLE	...
	WAVE-SPREADING-FUNCTION	...
	WAVE-STATISTICS	...

PURPOSE:

Create a named object.

PARAMETERS:

EVENT	Create an event.
FATIGUE-POINT	Create a fatigue point.
FUNCTION	Create a function.
INSPECTION	Create an inspection of a fatigue point.
SN-CURVE	Create an SN curve.
TRANSFER-FUNCTION	Create a transfer function.
VARIABLE	Create a random variable.
WAVE-SPREADING-FUNCTION	Create a wave spreading function.
WAVE-STATISTICS	Create a wave statistics formulation.

NOTES:

None.

CREATE EVENT

<table>
<tr><td rowspan="4">...</td><td rowspan="4">EVENT</td><td rowspan="4">name</td><td rowspan="4">desc</td><td>CONDITIONED</td><td>event</td><td colspan="2">condition</td></tr>
<tr><td>INTERSECTION</td><td colspan="3">subevent+</td></tr>
<tr><td>SINGLE</td><td>1d-variable</td><td><, =, ></td><td>threshold</td></tr>
<tr><td>UNION</td><td colspan="3">subevent+</td></tr>
</table>

PURPOSE:

To create an event.

PARAMETERS:

name	Name of the event. This cannot be the name of an existing event. Event names are matched case insensitively and can not be longer than 12 characters.
desc	Descriptive text for the event. It can be up to 50 characters long.
CONDITIONED	The event is a conditioned event.
event	The name of the event that is being conditioned.
condition	The name of the event that is forming the condition.
INTERSECTION	The event is an intersection of other events, i.e. it is fulfilled only when all subevents are fulfilled.
UNION	The event is a union of other events, i.e. it is fulfilled when at least one subevent is fulfilled.
subevent+	A selection of events forming either an intersection of union. These cannot be conditioned events.
SINGLE	The event is a simple (in)equality.
1d-variable	The name of the one dimensional variable that is forming the left hand side if the (in)equality.
< , = , >	One of: < less than, = equal, > greater than
threshold	The numerical right hand side of the single event.

NOTES:

See also:

- CHANGE EVENT

- COPY EVENT
- RENAME EVENT
- DELETE EVENT
- DISPLAY EVENT
- PRINT EVENT
- ASSIGN STARTING-POINT
- ASSIGN MEASURED-VALUE

EXAMPLES:

```
CREATE EVENT Loss 'Negative net present value' NPV 0
CREATE EVENT No1-Crack2 'Both inspections' INTERSECTION ( ONLY NoCrack-1 Crack2 )
CREATE EVENT Fail-Cond 'Failure given nofind, then find’ CONDITIONED Failure No1-
Crack2
```

CREATE FATIGUE-POINT

<table>
<tr><td rowspan="5">...</td><td rowspan="5">FATIGUE-POINT</td><td rowspan="5">name</td><td rowspan="5">desc</td><td rowspan="2">JOINT</td><td rowspan="2">Joint, Brace</td><td>CHORD</td><td rowspan="2">Hotspot</td></tr>
<tr><td>BRACE</td></tr>
<tr><td>MEMBER</td><td colspan="3">Member, Position, Hotspot</td></tr>
<tr><td>PLATE</td><td colspan="3">Width, Thickness</td></tr>
<tr><td>TUBE</td><td colspan="3">OutDia, Thickness</td></tr>
</table>

PURPOSE:

To create a fatigue point.

PARAMETERS:

name	Name of the fatigue point. This name must be unique among fatigue points and no longer than 8 characters. Names are matched case insensitively. This is referred to as NAME in the naming of stochastic parameters below.
desc	Descriptive text associated with the fatigue point.
JOINT	The point is positioned in a chord/brace connection in a joint, as defined in a Framework database.
Joint	The name of the joint where the point is located.
Brace	The name of a brace connecting to the joint.
CHORD	The point is sitting in the chord.
BRACE	The point is sitting in the brace.
Hotspot	Hotspot number.
MEMBER	The point is positioned on a member, as defined in a Framework database.
Member	The name of the member where the point is located.
Position	Fatigue check position on the member, as defined in a Framework database.
PLATE	The point is positioned in a plate geometry. In this case the user must supply all relevant data, i.e. the program does not associate it with any specific structure.
Width	The width of the plate. Uncertainty can be assigned to the parameter NAME-Width.
Thickness	The thickness of the plate, or the wall thickness of the tube. Uncertainty can be assigned to the parameter NAME-Thick.

OutDia	Outer diameter of the tube. An equivalent width is calculated as 3.14*OutDia, for use with plate geometry functions. Uncertainty can be assigned to the parameter NAME-ODiam.
TUBE	The point is positioned in a tube geometry. In this case the user must supply all relevant data, i.e. the program does not associate it with any specific structure.

NOTES:

The JOINT and MEMBER options require access to a Framework database.

See also:

- ASSIGN TARGET-RELIABILITY
- ASSIGN INSPECTION-QUALITY
- ASSIGN STRESS-RANGE
- ASSIGN SN-CURVE
- ASSIGN MINER-SUM-CRITICAL
- ASSIGN CRACK-GROWTH-MODEL
- ASSIGN GEOMETRY-FUNCTION
- ASSIGN WELD-EFFECT
- CREATE INSPECTION
- PRINT FATIGUE-POINT

EXAMPLES:

```
CREATE FATIGUE-POINT I4567-3 'Hotspot 12 in joint 4567' PLATE 1000 10
CREATE FATIGUE-POINT C3501 'Chord 3501, critical hotspot' JOINT 3501 1900 CHORD 3
```

CREATE FUNCTION

...	FUNCTION	name	desc	FORMULA	...
				INTEGRAL	...
				RESPONSESURFACE	...

PURPOSE:

To create a function.

PARAMETERS:

name	Name of the function. This name must be unique among functions and no longer than 12 characters. Names are matched case insensitive.
desc	Descriptive text associated with the function formula.
FORMULA	Create a function formula.
INTEGRAL	Create an integration function.
RESPONSESURFACE	Create a response surface function.

NOTES:

None.

CREATE FUNCTION ... FORMULA

...	FORMULA	{	argname	argdesc	}*	formula-text

PURPOSE:

To create a function formula.

PARAMETERS:

argname, argdesc	A matrix of argument names and corresponding argument descriptions. At least one argument must be defined.
formula-text	Formula text lines.

NOTES:

1 An argument name consists of maximum 12 alphanumeric characters and _. The first character must be alphabetic.

2 An argument description consists of maximum 50 characters.

3 A formula is input through a number of lines that are concatenated. The order of calculation is according to the FORTRAN syntax. See the syntax below.

Unary operators:	+ plus sign, - minus sign	
Binary operators:	+ addition , - subtraction, * multiplication, / division, ** exponentiation	
Separator:	, separates the elements of a function argument/option list	
Delimiters:	(left parenthesis,) right parenthesis. Delimits a function argument/option list and a portion of a formula.	
Operators...	Association	Precedence
FUNAM(,), ()	left to right	5
**	right to left	4
Unary +, Unary -	right to left	3
*,/	left to right	2
binary +, binary -	left to right	1
Quotes:'	delimits a character value. An apostrophe within a quoted text must be entered as '' in graphics mode and as "" in line mode/on journal file.	
Blanks	Blanks are deleted except within quoted texts.	
Hyphen -:	A hyphen - in the defined name for a function, function option or function option menu entry, must be entered as _. Names should be unique when - is replaced by _.	

Case sensitivity:	The formula text is case insensitive, except within a quoted string (function option value).
Function option:	A function option is entered as OPTION_NAME=OPTION-VALUE.

See also:

- CHANGE FUNCTION
- DISPLAY FUNCTION
- PRINT FUNCTION
- RENAME FUNCTION

EXAMPLES:

```
CREATE FUNCTION SYMFOR1 'Symbolic formula' FORMULA ( ONLY A 'Arg A' B 'Arg B' )
'(A+B)**2'
CREATE FUNCTION SYMFOR2 'Symbolic formula' FORMULA ( 'A+FUNOPT( OPT_NAM_1 ='
'Quot''''-1'', OPT_NAM_2 = file.name, OPT_NAM_3 = MENU_ENTRY, OPT_NAM_4 = 3,
OPT_NAM_5 = 0.5E-3, B*3-A)' )
```

CREATE FUNCTION ... INTEGRAL

...	INTEGRAL	{	argname	argdesc	}*	function	{	value integrator	}*	...

...	method	lowerbound	upperbound	tolerance

PURPOSE:

To create an integration function.

PARAMETERS:

argname, argdesc	Matrix of argument names and corresponding argument descriptions. At least one argument must be defined.
function	Name of function to be integrated (integrand).
value	Value can be a numerical value or an input argument name, “argname”.
integrator	Text value: integrator. Case insensitive. The text value “integrator” is inserted in order to identify the single integration variable.
method	Integration method to be used. One of: ROMBERG, SIMPSON or TRAPEZOIDAL.
lowerbound	Lower bound for integrator. Must be a numerical value or an argument name, “argname”.
upperbound	Upper bound for integrator. Must be a numerical value or an argument name, “argname”
tolerance	Relative precision in result of integration.

NOTES:

1 An argument name consists of maximum 12 alphanumeric characters and _. The first character must be alphabetic.

2 An argument description consists of maximum 50 characters.

3 The text value “integrator” may be an attribute of more than one function parameter.

See also:

- CHANGE FUNCTION ... INTEGRAL
- DISPLAY FUNCTION

- PRINT FUNCTION
- RENAME FUNCTION

EXAMPLES:

Integrate c+x from x=a to x=b:

```
CREATE FUNCTION cplusx 'Integrate c+x from from a to b' INTEGRAL ( ONLY a 'x_lower'
b 'x_upper' c 'additive parameter' ) SUM ( ONLY c Integrator ) Romberg a b 0.000001
```

CREATE FUNCTION ... RESPONSESURFACE

...	RESPONSESURFACE	{	argname	argdesc	}*	function	...

...	{	point,argname,method,increment	}*

PURPOSE:

To create a response surface function.

PARAMETERS:

argname, argdesc — Matrix of argument names and corresponding argument descriptions. At least one argument must be defined.

function — Name of function to be approximated.

point — Centre of approximations

argname — Argument name. This approximated function argument becomes the argument argname of the approximation.

method — Function fit method to be used.

L or L1: Linear approximation based on positive incrementation.

L2 : Linear approximation based on two way incrementation.

D : Quadratic (diagonal) approximation. No cross derivatives with other arguments.

QName :Q followed by name. Quadratic approximation including cross terms for arguments that have the same group Name. Q alone is treated as a group.

increment — Increment to be used with the fit.

NOTES:

1 An argument name consists of maximum 12 alphanumeric characters and _. The first character must be alphabetic.

2 An argument description consists of maximum 50 characters.

3 Point,argname,method and increment are comma separated.

See also:

- CHANGE FUNCTION ... RESPONSESURFACE
- DISPLAY FUNCTION

- PRINT FUNCTION
- PRINT RESPONSESURFACE
- RENAME FUNCTION

EXAMPLES:

Fit a quadratic response surface function to appfunc centred around (1,2,3), with increment 1 for the second argument of appfunc and increment 2 for the third argument of appfunc including cross terms. The response function has two arguments, while the approximated function has three arguments:

```
CREATE FUNCTION rspfu 'Response surface' RESPONSESURFACE ( ONLY a 'x_arg1' b
'x_arg2' ) appfunc 1 2,a,QGroup,1 3,b,QGroup,2
```

Fit linear response surface function to appfunc centred around (1,2,3), with increment 1 for each argument. the second argument of appfunc and increment 2 for the third argument of appfunc including cross terms:

```
CREATE FUNCTION rspfu 'Response surface' RESPONSESURFACE ( ONLY a 'x_arg1' b
'x_arg2' c 'x_arg3' ) appfunc 1,c,L,1 2,b,L1,1 3,a,L2,1
```

CREATE INSPECTION

...	INSPECTION	name	desc	fatigpnt	time	...

<table>
<tr><td rowspan="6">...</td><td colspan="3">NOT-OBSERVED</td><td rowspan="6">...</td></tr>
<tr><td>NO-CRACK-FOUND</td><td colspan="2">dpod</td></tr>
<tr><td rowspan="4">CRACK-FOUND</td><td>UNKNOWN</td><td>dpod</td></tr>
<tr><td>GREATER-THAN</td><td>depth</td></tr>
<tr><td>EQUAL-TO</td><td>depth</td></tr>
<tr><td>LESS-THAN</td><td>depth</td></tr>
</table>

<table>
<tr><td rowspan="6">...</td><td colspan="3">NOT-OBSERVED</td></tr>
<tr><td>NO-CRACK-FOUND</td><td colspan="2">lpod</td></tr>
<tr><td rowspan="4">CRACK-FOUND</td><td>UNKNOWN</td><td>lpod</td></tr>
<tr><td>GREATER-THAN</td><td>length</td></tr>
<tr><td>EQUAL-TO</td><td>length</td></tr>
<tr><td>LESS-THAN</td><td>length</td></tr>
</table>

PURPOSE:

Create an inspection at an existing fatigue point.

PARAMETERS:

name	Name of the inspection. This name must be unique among fatigue points and inspections and no longer than 8 characters. Names are matched case insensitively. This is referred to as NAME in the naming of stochastic parameters below.
desc	Descriptive text associated with the inspection.
fatigpnt	The name of the fatigue point at which the inspection was performed.
time	The time in years (decimal) at which the inspection is performed.
NOT-OBSERVED	The given crack direction was not observed.
NO-CRACK-FOUND	No crack was found in the given direction, i.e. any crack present is less than the detectable crack size.
CRACK-FOUND	A crack was found in the given direction, either GREATER-THAN, EQUAL-TO or LESS-THAN the specified size.

lpod	The smallest detectable crack length (defines the POD curve), referenced as the name of a random variable. Note that this is the full crack length, even though the geometry function is usually modelled in half crack lengths.
dpod	The smallest detectable crack depth (defines the POD curve), referenced as the name of a random variable.
length	Measured crack length. Note that this is the full crack length, even though the geometry function is usually modelled in half crack lengths. Uncertainty can be assigned to the parameter NAME-Length.
depth	Measured crack depth. Uncertainty can be assigned to the parameter NAME-Depth.

NOTES:

1 Any repair is taken into account by subsequent use of the ASSIGN REPAIR command.

2 It is not possible to create two inspections at the same inspection time at the same point.

3 A number of POD curves are predefined. See chapter 2 for details.

4 The inspection assignments can be printed by use of the command PRINT INSPECTION.

See also:

- RUN CRACK-GROWTH-ANALYSIS
- ASSIGN REPAIR

EXAMPLES:

```
CREATE INSPECTION C3501-1 'First inspection' C3501 6 NOT-OBSERVED NO-CRACK PODL-
MPI-UW
```

CREATE SN-CURVE

<table>
<tr><td rowspan="3">...</td><td rowspan="3">SN-CURVE</td><td rowspan="3">name</td><td>USER</td><td>text, m0, S0, logN0</td><td rowspan="3">...</td></tr>
<tr><td>LOGA</td><td>text, m0, loga0, logN0</td></tr>
<tr><td>STOCHASTIC</td><td>text, m0, logk0, sd(logk0), logN0</td></tr>
</table>

<table>
<tr><td rowspan="6">...</td><td colspan="4">DEFAULT-TAIL</td></tr>
<tr><td colspan="4">ALIGNED-WITH-FIRST</td></tr>
<tr><td colspan="4">HORISONTAL-TAIL</td></tr>
<tr><td rowspan="3">ARBITRARY-TAIL</td><td rowspan="3">m1</td><td colspan="2">ALIGNED-WITH-SECOND</td></tr>
<tr><td>HORISONTAL-TAIL</td><td>logN1</td></tr>
<tr><td>ARBITRARY-TAIL</td><td>logN1, m2</td></tr>
</table>

PURPOSE:

Create a SN-curve with up to 3 segments.

PARAMETERS:

name	SN-curve name. This name must be unique among SN curves and no longer than 8 characters. Names are matched case insensitively.
USER	The SN curve is specified using the stress level S at the end of the first segment.
LOGA	The SN curve is specified using the value of loga (sometimes named logk), usually incorporating a safety factor.
STOCHASTIC	The SN curve is specified with parameters that can be stochastic.
text	Text associated with SN-curve.
m0	Inverse slope of first segment. When a STOCHASTIC curve is assigned to a fatigue point or inspection with name NAME, uncertainty can be assigned to the parameter NAME-m0.
S0	Stress level at end first segment.
logN0	Log10 cycles to failure at end first segment. When a STOCHASTIC curve is assigned to a fatigue point or inspection with name NAME, uncertainty can be assigned to the parameter NAME-lN0.

loga0	Log10 of parameter a at first segment ($N \cdot S^m = a$). This value usually incorporates a safety factor, i.e. it is related to logk0 as: loga0 = logk0 - 2*stdv(logk0)
logk0	Log10 of parameter k at first segment ($N \cdot S^m = k$). This value usually does not incorporate a safety factor. The relation to loga0 is described above.
sd(logk0)	The standard deviation of log10(k0). In a deterministic analysis, log10(a0) = log10(k0) - 2*stdv(log10(k0)) is used. In a probabilistic analysis, log10(k0) has a Normal distribution with mean log(k0) and this standard deviation.
DEFAULT-TAIL	Second segment continues with m1 = 2*m0 - 1.
ALIGNED-WITH-FIRST	Second segment continues with m1 = m0.
HORISONTAL-TAIL	Second segment is horizontal.
ARBITRARY-TAIL	Second segment is arbitrary.
m1	Inverse slope of second segment. When a STOCHASTIC curve is assigned to a fatigue point or inspection with name NAME, uncertainty can be assigned to the parameter NAME-m1.
ALIGNED-WITH-SECOND	Third segment continues with m2 = m1.
HORISONTAL-TAIL	Third segment is horizontal.
logN1	Log10 cycles to failure at end second segment. When a STOCHASTIC curve is assigned to a fatigue point or inspection with name NAME, uncertainty can be assigned to the parameter NAME-lN1.
m2	Inverse slope of third segment. When a STOCHASTIC curve is assigned to a fatigue point or inspection with name NAME, uncertainty can be assigned to the parameter NAME-m2.

NOTES:

1 To change the uncertainty of a parameter, use the command ASSIGN UNCERTAINTY VALUE.

2 A number of SN curves are predefined in units N/m^2. These are listed in Chapter 2.

3 Any thickness correction must be assigned separately, using the command ASSIGN THICKNESS-CORRECTION.

4 The number of cycles to failure (N) for a given stress range (S) is computed according to the following formula (see also the figure below):

$$N \cdot S^m = k$$

$$\log N = \begin{cases} \log k_0 - (m_0 \cdot \log S) & \text{for} \quad (S > S_0) \\ \log k_1 - (m_1 \cdot \log S) & \text{for} \quad (S_1 < S < S_0) \\ \log k_2 - (m_2 \cdot \log S) & \text{for} \quad (S_2 < S_1) \end{cases}$$

5 Please remember to be consistent in the use of units. See also Section 2.5.1.

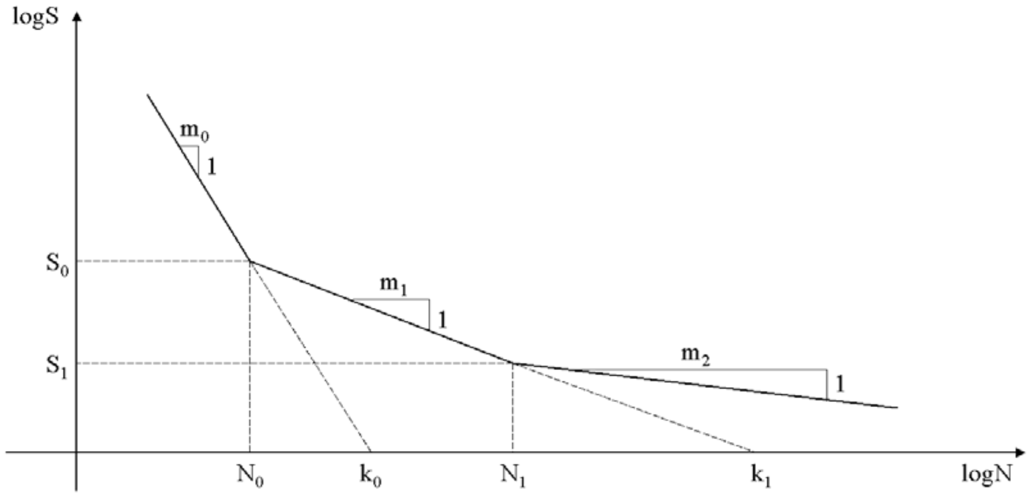


Figure 5.2 Definition of an SN-curve

See also:

- ASSIGN SN-CURVE
- CHANGE SN-CURVE
- DISPLAY SN-CURVE
- PRINT SN-CURVE

EXAMPLES:

These command will redefine the built-in DNV-X curve to units N/mm^2.

```
CREATE SN-CURVE DNVX USER 'Veritas X-curve' 4.1 34 8.301 HORISONTAL-TAIL
```

```
CREATE SN-CURVE DNVX STOCHASTIC 'Veritas X-curve' 4.1 13.78 0.4 8.301 HORISONTAL
TAIL
```

CREATE TRANSFER-FUNCTION

<table>
<tr><td>...</td><td>TRANSFER-FUNCTION</td><td>name</td><td>desc</td><td>...</td></tr>
</table>

<table>
<tr><td rowspan="3">...</td><td>GENERAL-COMBINATION</td><td>{</td><td>trf, fact</td><td>}*</td></tr>
<tr><td>USER-SPECIFIED</td><td>{</td><td>depth, dir, freq, real, imag</td><td>}*</td></tr>
<tr><td>RESULT</td><td colspan="2">superelement</td><td>...</td></tr>
</table>

<table>
<tr><td rowspan="6">...</td><td rowspan="3">ELEMENT</td><td rowspan="3">elem</td><td>FORCE</td><td>pos</td><td>COMP</td></tr>
<tr><td>STRESS</td><td>gauss</td><td>COMP</td></tr>
<tr><td>STRAIN</td><td>gauss</td><td>COMP</td></tr>
<tr><td rowspan="3">NODE</td><td rowspan="3">node</td><td>DISPLACEMENT</td><td colspan="2" rowspan="3">COMP</td></tr>
<tr><td>VELOCITY</td></tr>
<tr><td>ACCELERATION</td></tr>
</table>

PURPOSE:

Create a transfer function,

PARAMETERS:

name	Name of the transfer function. This name must be unique among transfer functions and no longer than 8 characters. Names are matched case insensitively. This is referred to as NAME in the naming of stochastic parameters below.
desc	A descriptive text for the transfer function.
GENERAL-COMBINATION	The transfer function is a linear combination of existing transfer functions.
trf,fact*	A set of transfer function names and corresponding coefficients in the linear combination, i.e. $trf_{new} = \Sigma\ trf_i * fact_i$
USER-SPECIFIED	The transfer function is given as a set of data points.
depth	Water depth.
dir,freq, real, imag*	Transfer function data in sets of: (direction in degrees, frequency, real part, imaginary part).
RESULT	Read the transfer function from a SESAM interface file (opened by use of FILE OPEN).

superelement	The number of the superelement from which the function is read.
ELEMENT elem	The transfer function is a result on an element with the specified number.
FORCE	The function is a force.
STRESS	The function is a stress.
STRAIN	The function is a strain.
pos	Position on the element.
COMP	Component.
gauss	Gauss point.
NODE node	The transfer function is a result on a node with the specified number.
DISPLACEMENT	The function is a displacement.
VELOCITY	The function is a velocity.
ACCELERATION	The function is an acceleration.

NOTES:

See also:

- ASSIGN TRANSFER-FUNCTION
- CHANGE TRANSFER-FUNCTION
- DISPLAY TRANSFER-FUNCTION
- PRINT TRANSFER-FUNCTION
- FILE OPEN

EXAMPLES:

```
CREATE TRANSFER-FUNCTION T1123-31 'Element 1123, Pos 3, Axial force' RESULT 1 EL-
EMENT 1123 FORCE 3 1
CREATE TRANSFER-FUNCTION TRF1-3 GENERAL-COMBINATION TRF1 3.0
CREATE TRANSFER-FUNCTION TRF12 GENERAL-COMBINATION ( ONLY TRF1 0.5 TRF2 0.5 )
```

CREATE VARIABLE

<table>
<tr><td rowspan="6">...</td><td rowspan="6">VARIABLE</td><td rowspan="6">name</td><td rowspan="6">desc</td><td>DISTRIBUTION</td><td>...</td></tr>
<tr><td>FITTED-DISTRIBUTION</td><td>...</td></tr>
<tr><td>FIXED</td><td>value</td></tr>
<tr><td>FUNCTION</td><td>...</td></tr>
<tr><td>GENERATED</td><td>1dvar</td></tr>
<tr><td>IDENTITY</td><td>variable</td></tr>
</table>

PURPOSE:

To create a variable.

PARAMETERS:

name	Name of the variable to be created. This cannot be the name of an existing variable. Variable names are matched case insensitively and can be up to 12 characters long.
desc	Descriptive text for the variable. It can be up to 50 characters long.
DISTRIBUTION	The variable is assigned a distribution. See a following page for details.
FITTED-DISTRIBUTION	The variable is assigned a distribution that is fitted to input data. See a following page for details.
FIXED	The variable has a fixed value.
value	The numerical value of a fixed variable.
FUNCTION	The variable is assigned a model function. See a following page for details.
GENERATED	The distribution of the variable is generated from the distribution of another variable.
1dvar	The variable specifying a generated distribution. This is a one-dimensional variable or a coordinate in a multidimensional variable.
IDENTITY	The variable is identical to another variable.
variable	The name of an existing variable.

NOTES:

1 Some of the variables in a generated distribution may be shared between the generated variable and the generating variable by using the ASSIGN CONDITIONING command.

2 A generated distribution may be assigned an extreme type distribution by using the ASSIGN EXTREME-VALUE command.

See also:

- CHANGE VARIABLE
- COPY VARIABLE
- DELETE VARIABLE
- RENAME VARIABLE
- PRINT VARIABLE
- ASSIGN CONDITIONING
- ASSIGN EXTREME-VALUE

EXAMPLES:

```
CREATE VARIABLE Width 'Width of plate' FIXED 22.5
CREATE VARIABLE Amplitude 'Wave amplitude' GENERATED Var44
```

CREATE VARIABLE ... DISTRIBUTION

...	DISTRIBUTION	distribution	[dim]	input-seq	parameters
		SPLINE-1DIM	...		

PURPOSE:

To create a variable to be based on a distribution.

PARAMETERS:

distribution — The name of the distribution (excepting the spline distribution).

[dim] — The dimension of the distribution, if this is not fixed.

input-seq — The sequence of parameters used to define the distributions.

parameters — The parameter value(s) for the chosen input sequence. Each parameter value may be either a numerical value or the name of an existing one-dimensional variable. Please note that the name of a variable cannot be abbreviated here.

SPLINE-1DIM — The variable is assigned a distribution, fitted to input data. See a following page for details.

NOTES:

1 The variable may be assigned an extreme type distribution by using the ASSIGN EXTREME-VALUE command.

2 The distribution function and density values may be printed by use of the PRINT DISTRIBUTION command.

3 The moments of the distribution are calculated and printed (if possible) by use of the PRINT VARIABLE command.

4 The distributions are described in SESAM User's Manual: Proban Distributions.

See also:

- CHANGE VARIABLE
- DISPLAY DISTRIBUTION
- PRINT VARIABLE
- PRINT DISTRIBUTION
- ASSIGN CORRELATION

- ASSIGN EXTREME-VALUE

EXAMPLES:

```
CREATE VARIABLE X ' ' DISTRIBUTION Normal Mean-CoV 22 0.2
CREATE VARIABLE Y ' ' DISTRIBUTION Normal Mean-Std X 3.1
```

CREATE VARIABLE ... DISTRIBUTION SPLINE-1DIM

<table>
<tr><td rowspan="2">...</td><td rowspan="2">SPLINE-1DIM</td><td rowspan="2">lower</td><td rowspan="2">upper</td><td>UNWEIGHTED</td><td>{</td><td>fractile</td><td>probability</td><td>}*</td><td colspan="2">...</td></tr>
<tr><td>WEIGHTED</td><td>{</td><td>fractile</td><td>probability</td><td>weight</td><td>}*</td><td>...</td></tr>
</table>

<table>
<tr><td rowspan="4">...</td><td>HIGH</td><td rowspan="4">...</td><td rowspan="3">FREE</td><td>EQUAL</td></tr>
<tr><td>MEDIUM</td><td>FREE</td></tr>
<tr><td rowspan="2">LOW</td><td>VANISH</td></tr>
<tr><td colspan="2">UNIMODAL</td></tr>
</table>

PURPOSE:

To create a variable to have a fitted distribution based on splines.

PARAMETERS:

lower	The lower bound of the distribution.
upper	The upper bound of the distribution.
UNWEIGHTED	Do not apply user defined weights to the spline fit.
WEIGHTED	Apply user defined weights to the input points in the spline fit.
fractile, probability	The fractiles and probability values to which the distribution function is fitted. All probabilities must be greater than 0 and smaller than 1.
fractile, probability, weighted	The fractiles and probability values to which the distribution function is fitted with corresponding weights. All probabilities must be greater than 0 and smaller than 1.
HIGH	Use high accuracy when fitting the spline distribution to the data. In some cases it may be difficult to get convergence when high accuracy is used.
MEDIUM	Use medium accuracy when fitting the spline distribution to the data.
LOW	Use low accuracy when fitting the spline distribution to the data.
FREE	The fitted distribution need not be unimodal.
UNIMODAL	The fitted distribution must be unimodal.
EQUAL	The tail values of a FREE fit must be identical.

FREE	No restriction on the tail values of a FREE fit, except that they are non-negative.
VANISH	Both tail values of a FREE fit must be zero.

NOTES:

1 If the spline will not fit, try relaxing the demands on accuracy or check if any of the points have been specified wrongly.

2 The variable may be assigned an extreme type distribution by using the ASSIGN EXTREME-VALUE command.

3 The distribution function and density values may be printed by use of the PRINT DISTRIBUTION command.

4 The moments of the distribution are calculated and printed (if possible) by use of the PRINT VARIABLE command.

5 The distribution itself may be displayed using DISPLAY DISTRIBUTION. The accuracy of the fit may be examined using DISPLAY FITTED-DISTRIBUTION.

See also:

- CHANGE VARIABLE
- DISPLAY DISTRIBUTION
- DISPLAY FITTED-DISTRIBUTION
- PRINT VARIABLE
- PRINT DISTRIBUTION
- ASSIGN CORRELATION
- ASSIGN EXTREME-VALUE

EXAMPLES:

```
CREATE VARIABLE X ' ' DISTRIBUTION Spline-1Dim 0 10 UNWEIGHTED ( ONLY 1.0 0.5 3.0
0.25 5.0 0.5 7.0 0.7 8.0 0.9 9.0 0.95 ) HIGH UNIMODAL
```

CREATE VARIABLE ... FITTED-DISTRIBUTION

...	FITTED-DISTRIBUTION	distribution	input-seq	parameter*	...

...	CUMULATIVE	WEIGHTED	{	fractile	probability	weight	}*
		UNWEIGHTED	{	fractile	probability	}*	
	OBSERVATIONS	WEIGHTED	{	observation	weight	}*	
		UNWEIGHTED	{	observation	}*		
	RESULT	result name					

PURPOSE:

To create a variable to be fitted to a distribution.

PARAMETERS:

distribution	The name of the distribution (excepting the spline distribution and multidimensional distributions).
input-seq	The sequence of parameters used to define the distributions.
parameter*	The parameter specification for the chosen input sequence. Each parameter value may be either specified as a numerical value (in which case it is not fitted), as: FIT, in which case it is fitted, or as: FIT<value>, where <value> is a numerical value used as starting point for an iterative fit. A lower bound on the fitted value is specified by L<value>. An upper bound on the fitted value is specified by U<value>.
CUMULATIVE	Fit to cumulative input data.
WEIGHTED	The input data are weighted. The weights must be positive.
UNWEIGHTED	The input data are not weighted.
fractile, probability, weight	Successive values of fractiles, cumulative probabilities and weights. The probabilities must be in the interval]0,1[. The input data will be sorted in order of increasing probability.
fractile, probability	Successive values of fractiles and cumulative probabilities. The probabilities must be in the interval]0,1[. The input data will be sorted in order of increasing probability.
OBSERVATIONS	The input data are observed values of the variable.
observation, weight	Successive values of observations and weights. The input data will be sorted in order of increasing observation values.

observation	Observed values of the random variable to which a distribution is fitted. The input data will be sorted in order of increasing observation values.
RESULT	Fit the distribution to the results of a probability or distribution analysis. Simulation results will be fitted and stored as OBSERVATIONS, after being grouped into weighted interval data if many samples exist. Mean value based FORM results will be fitted and stored as CUMULATIVE data with equal weights on all points. Probability results from a parameter study will be fitted (if possible) and stored as CUMULATIVE data with equal weights on all points. In the case of a parameter study of a distribution analysis, the result for the first parameter value is used.
result name	The name of the result for which the distribution is to be fitted.

NOTES:

1 The existing values are presented as defaults whenever this is possible.

2 The RESULT option can be useful for substituting a variable requiring lengthy computation time with a fitted distribution.

3 The variable may be assigned an extreme type distribution by using the ASSIGN EXTREME-VALUE command.

4 The distribution function and density values may be printed by use of the PRINT DISTRIBUTION command.

5 The moments of the distribution are calculated and printed (if possible) by use of the PRINT VARIABLE command.

6 The distribution itself may be displayed using DISPLAY DISTRIBUTION. The accuracy of the fit may be examined using DISPLAY FITTED-DISTRIBUTION.

7 The distributions are described in SESAM User's Manual: Proban Distributions.

See also:

- CREATE VARIABLE
- DISPLAY DISTRIBUTION
- DISPLAY FITTED-DISTRIBUTION
- PRINT VARIABLE
- PRINT DISTRIBUTION
- ASSIGN EXTREME-VALUE

EXAMPLES:

```
CREATE VARIABLE X ' ' FITTED-DISTRIBUTION Normal Mean-CoV FIT FIT OBS UNW ( ONLY
1.34 2.56 8.65 4.32 4.67 6.66 5.23 3.25 )
CREATE VARIABLE Y ' ' FITTED-DISTRIBUTION Normal Mean-Std FIT15 FIT CUMULATIVE
WEIGHTED ( ONLY 12 0.1 1 15 0.3 2 17 0.7 1 20 0.9 1 )
CREATE VARIABLE RES ' ' FITTED-DISTRIBUTION Lognormal Mean-Std-L FIT FIT 0 RESULT
LastAnalysis
```

CREATE VARIABLE ... FUNCTION

...	FUNCTION	function	[dim]	argument*

PURPOSE:

To create a variable to be a function of numerical values or other variables.

PARAMETERS:

function	The name of the function. The functions can be listed by use of the commands PRINT FUNCTION LIBRARY and PRINT FUNCTION DESCRIPTION.
[dim]	The dimension of the function, if this is not fixed.
argument*	The argument value(s) for the chosen function. Each argument value may be either a numerical value or the name of an existing one-dimensional variable. Please note that the name of a variable cannot be abbreviated here.

NOTES:

The selection of functions presented is determined by the current selection of sub-libraries (see SELECT FUNCTION-LIBRARY). This is because some libraries may contain a large number of functions and/or not be relevant to the current problem.

See also:

- CHANGE VARIABLE
- PRINT VARIABLE
- PRINT FUNCTION
- SELECT FUNCTION-LIBRARY

EXAMPLES:

```
CREATE VARIABLE Total-Durati 'Total duration of project' FUNCTION Sum ( EXCLUDE
Path-1 )
CREATE VARIABLE Diff1 ' ' FUNCTION Difference Resist5 Load4
```

CREATE WAVE-SPREADING-FUNCTION

<table>
<tr><td rowspan="2">...</td><td rowspan="2">WAVE-SPREADING-FUNCTION</td><td rowspan="2">name</td><td rowspan="2">desc</td><td>COSINE-POWER</td><td colspan="3">power</td></tr>
<tr><td>USER-DEFINED</td><td>{</td><td>wave-dir, weight</td><td>}*</td></tr>
</table>

PURPOSE:

Create a wave spreading function.

PARAMETERS:

name	Name of wave spreading function. This name must be unique among transfer functions and no longer than 8 characters. Names are matched case insensitively.
desc	Descriptive text associated with the spreading function.
COSINE-POWER	The spreading function is represented by a cosine function.
power	Power of the cosine function.
USER-DEFINED	The spreading function is defined by data points.
wave-dir, weight	A set of points defining the spreading function: - Wave direction, relative to the main wave direction. - Weight associated with wave direction.

NOTES:

The sum of weights must be 1.0.

See also:

- ASSIGN WAVE-SPREADING-FUNCTION
- CHANGE WAVE-SPREADING-FUNCTION
- DISPLAY WAVE-SPREADING-FUNCTION
- PRINT WAVE-SPREADING-FUNCTION

EXAMPLES:

```
CREATE WAVE-SPREADING-FUNCTION COS2 'Analytical cos**2' COSINE 2
```

CREATE WAVE-STATISTICS

...	WAVE-STATISTICS	name	desc	SCATTER-DIAGRAM	...

...	PROBABILITY	{	Hs, Tz, prob	}*
	OCCURRENCE	{	Hs, Tz, occr	}*

PURPOSE:

To create a wave scatter diagram.

PARAMETERS:

name	Name of wave statistics. This name must be unique among wave statistics and no longer than 8 characters. Names are matched case insensitively.
desc	Descriptive text associated with the wave statistics.
SCATTER-DIAGRAM	The wave statistics is a scatter diagram.
PROBABILITY	The scatter diagram shall be defined in terms of probability for each set of Hs and Tz values.
OCCURRENCE	The scatter diagram shall be defined in terms of occurrence for each set of Hs and Tz values.
Hs	Significant wave height of one sea state.
Tz	Zero up-crossing period for one sea state.
prob	Probability of occurrence for one sea state.
occr	Number of occurrences for one sea state.

NOTES:

1 If the sea states of the scatter diagram are defined in terms of probability then the sum of all probabilities must be 1.0.

2 A number of stochastic factors are assigned to each scatter diagram. The values of these factors may be changed by use of ASSIGN MODEL-FACTOR (see this command for details). The uncertainty may be changed by use of ASSIGN UNCVERTAINTY VALUE.

See also:

- ASSIGN WAVE-STATISTICS
- ASSIGN WAVE-SPECTRUM-SHAPE

- ASSIGN WAVE-SPREADING-FUNCTION
- ASSIGN WAVE-DIRECTION-PROBABILITY
- CHANGE WAVE-STATISTICS
- PRINT WAVE-STATISTICS
- ASSIGN MODEL-FACTOR SCATTER-DISTRIBUTION
- ASSIGN MODEL-FACTOR WAVE-SPECTRUM-SHAPE
- ASSIGN MODEL-FACTOR WAVE-SPREADING
- ASSIGN UNCERTAINTY VALUE

EXAMPLES:

```
CREATE WAVE-STATISTICS WS1 'Scatter diagram for SESAM field' SCATTER PROBABILITY
( 5.0 7.0 0.1 6.0 6.0 0.5 7.0 6.0 0.3 8.0 5.0 0.1 )
```

DEFINE

DEFINE	ANALYSIS-OPTION	...
	CALIBRATION-CRACK-GROWTH	...
	CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY	...
	CUTOFF-PD6493	...
	DISTRIBUTION-SIMULATION	...
	FATIGUE-CONSTANTS	...
	FORM-SORM	...
	MEAN-VALUE-FORM	...
	PARAMETER-STUDY	...
	PLAN-INSPECTION	...
	PRESENTATION	...
	PROBABILITY-SIMULATION	...
	SERVICE-LIFE	...
	SN-ANALYSIS	...
	FAILURE-PROBABILITY	...
	TRANSFER-FUNCTION	...
	UNCERTAINTY	...
	WEIBULL-FIT	...

PURPOSE:

Define global parameters or analysis options.

PARAMETERS:

ANALYSIS-OPTION	Define general options for distribution and probability analysis.
CALIBRATION-CRACK-GROWTH	Define calibration of the crack growth model to the SN reliability result.
CRACK-GR-AN FAILURE-PROBABILITY	Define how a failure probability crack growth analysis is executed.
CUTOFF-PD6493	Define the cut off value for PD6493.
DISTRIBUTION-SIMULATION	Define simulation of distributions.

FATIGUE-CONSTANTS	Define constants applied to SCFs read from a Framework database.
FORM-SORM	Define options for FORM and SORM probability analysis.
MEAN-VALUE-FORM	Define how a mean based FORM distribution analysis is performed.
PARAMETER-STUDY	Define values of a parameter for repeated analysis as a function of this parameter.
PLAN-INSPECTION	Define how an inspection plan is executed.
PRESENTATION	Define options used for presentation (print and display).
PROBABILITY-SIMULATION	Define options for simulation of probabilities.
SERVICE-LIFE	Define the service life for the structure being analysed.
SN-ANALYSIS FAILURE PROBABILITY	Define how an SN analysis of the failure probability is executed.
TRANSFER-FUNCTION	Define how transfer functions are applied.
UNCERTAINTY	Define the default uncertainty for a parameter.
WEIBULL-FIT	Define data points for a Weibull fit to the stress range distribution.

DEFINE ANALYSIS-OPTION

<table>
<tr><td rowspan="21">...</td><td rowspan="21">ANALYSIS-OPTION</td><td>DIFFERENTIATION</td><td colspan="2">uspace1, uspace2, rel, abs, limit</td></tr>
<tr><td rowspan="2">GRADIENT-CALCULATION</td><td colspan="2">ANALYTICAL</td></tr>
<tr><td colspan="2">NUMERICA</td></tr>
<tr><td rowspan="2">IMPORTANCE-FACTORS</td><td colspan="2">ON</td></tr>
<tr><td colspan="2">OFF</td></tr>
<tr><td rowspan="7">INTERMEDIATE-RESULTS</td><td rowspan="2">GRADIENT-VALUES</td><td>ON</td></tr>
<tr><td>OFF</td></tr>
<tr><td>LEVEL</td><td>level</td></tr>
<tr><td rowspan="2">POINT-VALUES</td><td>ON</td></tr>
<tr><td>OFF</td></tr>
<tr><td rowspan="2">SHOW-DURING-ANALYSIS</td><td>ON</td></tr>
<tr><td>OFF</td></tr>
<tr><td rowspan="2">PARAMETER-STUDY</td><td colspan="2">ON</td></tr>
<tr><td colspan="2">OFF</td></tr>
<tr><td rowspan="3">SEEDS</td><td colspan="2">DEFAULT</td></tr>
<tr><td colspan="2">RANDOM</td></tr>
<tr><td colspan="2">seed1, seed2, seed3</td></tr>
<tr><td rowspan="3">SENSITIVITY</td><td colspan="2">ALL</td></tr>
<tr><td colspan="2">NONE</td></tr>
<tr><td colspan="2">SELECTED</td></tr>
<tr><td colspan="2">GENERATED-DISTRIBUTION</td><td>...</td></tr>
</table>

PURPOSE:

Define analysis options for probability and distribution analyses.

PARAMETERS:

DIFFERENTIATION	Define differentiation increments for use in FORM/SORM optimization and in calculation of sensitivity values.
uspace1	The differentiation increment in U-space. It must be positive.
uspace2	The differentiation increment for the hessian matrix in U-space. Used during the FORM/SORM optimization. It must be positive.

rel	Relative parameter increment. It must be positive.
abs	Absolute parameter increment. It must be positive.
limit	Limit for application of relative parameter increment. The absolute increment is used if the absolute value of the parameter is less than limit. It must be positive.
GRADIENT-CALCULATION	Determines if the gradients that have been programmed into the model functions are used (ANALYTICAL) or if all differentiation is done numerically (NUMERICAL).
IMPORTANCE-FACTORS	Controls if importance factors are calculated.
INTERMEDIATE-RESULTS	During an analysis, intermediate results may be stored on the database and possibly written to the screen. This is mainly in order to facilitate debugging of the program.
GRADIENT-VALUES	Controls if gradient values are shown during the analysis.
LEVEL level	Controls the amount of intermediate results to be generated. The possible alternatives are: NONE, LOW, MEDIUM, EXCESSIVE.
POINT/VALUES	Controls if point values (e.g. values of variables forming single events) are shown during the analysis.
SHOW-DURING-ANALYSIS	Controls whether the immediate results will be shown on the screen during the analysis run. Please take care, as excessive amounts of output may be generated.
PARAMETER-STUDY	Controls if an assigned parameter study is actually performed.
SEEDS	Controls specification of seeds for the pseudo-random number generator. The generator requires three integer seeds. If two otherwise identical sample sequences are started with the same seeds. they will produce the same results.
DEFAULT	The default seeds are: 699570728 398267609 1044576128. These are mostly useful for testing (reproduction of results).
RANDOM	The seeds are generated randomly from the date and time. This works quite well, and is recommended for most sample sequences.
seed1 seed2 seed3	A direct specification of the three integer seeds.
SENSITIVITY	Controls the extent of the parametric sensitivity calculation (does not control importance factor calculation). May be used to override the assignments done by the ASSIGN SENSITIVITY-CALCULATION command. The possible alternatives are:

	ALL (calculate all), SELECTED (calculate assigned values) or NONE.
GENERATED-DISTRIBUTION	Define analysis options for use of generated distributions. See a following page.

NOTES:

The current analysis settings may be printed by use of the PRINT ANALYSIS-SETTINGS command.

See also:

- DEFINE PARAMETER-STUDY
- ASSIGN SENSITIVITY-CALCULATION
- PRINT ANALYSIS-SETTINGS

EXAMPLE:

The following values are default when the program starts up with a new database:

```
DEFINE ANALYSIS-OPTION DIFFERENTIATION 0.001 0.1 0.0001 0.001 1.0E-10
DEFINE ANALYSIS-OPTION GRADIENT-CALCULATION ANALYTICAL
DEFINE ANALYSIS-OPTION IMPORTANCE-FACTORS ON
DEFINE ANALYSIS-OPTION INTERMEDITATE RESULTS GRADIENT-VALUES OFF
DEFINE ANALYSIS-OPTION INTERMEDITATE RESULTS LEVEL NONE
DEFINE ANALYSIS-OPTION INTERMEDITATE RESULTS POINT-VALUES OFF
DEFINE ANALYSIS-OPTION INTERMEDITATE RESULTS SHOW-DURING-ANALYSIS OFF
DEFINE ANALYSIS-OPTION PARAMETER-STUDY ON
DEFINE ANALYSIS-OPTION SEEDS RANDOM
DEFINE ANALYSIS-OPTION SENSITIVITY SELECTED
```

DEFINE ANALYSIS-OPTION GENERATED-DISTRIBUTION

...	GENERATED-DISTRIBUTION	...

<table>
<tr><td rowspan="13">...</td><td>DIFFERENTIATION</td><td>uspace1</td><td>uspace2</td><td>rel</td><td>abs</td><td>limit</td></tr>
<tr><td rowspan="3">GRADIENT-CALCULATION</td><td colspan="5">ANALYTICAL</td></tr>
<tr><td colspan="5">ONEWAY-INCREMENTATION</td></tr>
<tr><td colspan="5">TWOWAY-INCREMENTATION</td></tr>
<tr><td>U-SPACE-BOUNDS</td><td colspan="5">Value</td></tr>
<tr><td rowspan="4">INTERMEDIATE-RESULTS</td><td colspan="5">NONE</td></tr>
<tr><td colspan="5">LOW</td></tr>
<tr><td colspan="5">MEDIUM</td></tr>
<tr><td colspan="5">EXCESSIVE</td></tr>
<tr><td>FRACTILE-FROM-PROBABILITY</td><td>UNMIN</td><td>maxit</td><td>maxstep</td><td colspan="2">conv</td></tr>
<tr><td rowspan="3">PROBABILITY-FROM-FRACTILE</td><td>SQP</td><td>maxit</td><td>maxstep</td><td colspan="2">conv</td></tr>
<tr><td>NLPQL</td><td colspan="4">...</td></tr>
<tr><td>RFCRC</td><td colspan="4">...</td></tr>
</table>

PURPOSE:

Define analysis options for usage of generated distributions.

PARAMETERS:

DIFFERENTIATION	Define differentiation increments for use in optimization.
uspace1	The differentiation increment in U-space. It must be positive.
uspace2	The differentiation increment for the hessian matrix in U-space. Used during the FORM/SORM optimization. It must be positive.
rel	Relative parameter increment. It must be positive.
abs	Absolute parameter increment. It must be positive.
limit	Limit for application of relative parameter increment. The absolute increment is used if the absolute value of the parameter is less than limit. It must be positive.
GRADIENT-CALCULATION	Determines if the gradients that have been programmed into the model functions are used (ANALYTICAL), or if one way

	(u+du) or two way (u+du and u-du) incrementation is used to determine the gradient.
U-SPACE-BOUNDS	Initialises the u-space optimisation upper bounds to Value and the u-space lower bounds to -Value.
INTERMEDIATE-RESULTS	Controls the amount of intermediate results to be generated. The possible alternatives are: NONE, LOW, MEDIUM, EXCESSIVE.
FRACTILE-FROM-PROBABILITY	Defines the optimization method used to calculate a fractile from a probability value.
UNMIN	Unconstrained minimisation in polar coordinates.
maxit	The maximal number of iterations allowed.
maxstep	The maximal number of steps in one search direction.
conv	Convergence criterion.
PROBABILITY-FROM-FRACTILE	Defines the optimization method used to calculate a probability from a fractile value.
SQP	Sequential quadratic programming.
NLPQL	Sequential quadratic programming. Extended options set. See DEFINE ... NLPQL.
RFCRC	Robusted Rackwitz-Fiessler method. See DEFINE ... RFCRC.

NOTES:

The current analysis settings may be printed by use of the PRINT ANALYSIS-SETTINGS command.

See also:

- PRINT ANALYSIS-SETTINGS

EXAMPLE:

The following values are default when the program starts up with a new database:

```
DEFINE ANALYSIS-OPTION GENERATED-DISTRIBUTION DIFFERENTIATION 1.0E-6 1.0E-3 1.0E-
6 1.0E-6 1.0E-10
DEFINE ANALYSIS-OPTION GENERATED-DISTRIBUTION INTERMEDIATE-RESULTS NONE
DEFINE ANALYSIS-OPTION GENERATED-DISTRIBUTION FRACTILE-FROM-PROBABILITY UNMIN 40
10 1.72633D-7
DEFINE ANALYSIS-OPTION GENERATED-DISTRIBUTION PROBABILITY-FROM-FRACTILE SQP 40 10
1.72633D-7
```

DEFINE CALIBRATION-CRACK-GROWTH

...	CALIBRATION-CRACK-GROWTH	AUTOMATIC-UPDATE	ON/OFF
		DISTANCE-TO-SN	dist
		MAX-NUMBER-OF-STEPS	nstep
		STEP-LENGTH	eps
		TIME-POINTS	{Time}*

PURPOSE:

Define calibration of the crack growth model to the SN reliability result.

PARAMETERS:

AUTOMATIC-UPDATE ON/OFF	When ON, the parameter values are automatically updated after convergence has been achieved. When OFF, the parameter values must be updated manually.
DISTANCE-TO-SN dist	The required distance between the crack growth reliability indexes and SN reliability indexes at the specified time points.
MAX-NUMBER-OF-STEPS nstep	The maximum number of steps attempted to find a calibration result. Must be positive.
STEP-LENGTH eps	The maximal step length of the parameter values.
TIME-POINTS Time	The time points at which the calibration is made. At least two time points must be specified, and all must be greater than the start time specified by the command DEFINE SERVICE-LIFE.

NOTES:

1 Convergence is achieved when both the distance and step length criterion is satisfied. The iteration stops in any case if the step length is negligible.

2 For one dimensional crack growth models there is a limit to how small the distance can get. It may therefore be advisable to set a large distance criterion in this case.

See also:

- RUN CALIBRATION-CRACK-GROWTH
- ASSIGN CRACK-GROWTH-MODEL

EXAMPLE:

The following values are default when the program starts up with a new database:

```
DEFINE CALIBRATION-CRACK-GROWTH AUTOMATIC-UPDATE OFF
DEFINE CALIBRATION-CRACK-GROWTH DISTANCE-TO-SN 0.3
DEFINE CALIBRATION-CRACK-GROWTH MAX-NUMBER-OF-STEPS 10
DEFINE CALIBRATION-CRACK-GROWTH STEP-LENGTH 0.001
DEFINE CALIBRATION-CRACK-GROWTH TIME-POINTS % 20%, 50% and 100% of service life
```

DEFINE CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY

...	FAILURE-PROBABILITY	ANALYSIS-METHOD	FORM
			SORM
			DEFAULT
		IMPORTANCE-FACTORS	ON
			OFF
		NUMBER-OF-TIME-STEPS	nstep
		PARAMETRIC-SENSITIVITY	ON/OFF
		RUN-ANALYSIS-TO	INSPECTION
			SERVICE-LIFE-ERND
		MAX-NO.-OF-LATEST-INSPECTIONS	ninsp
		ANNUAL-OR-LIFETIME-PROBABILITY	ANNUAL
			LIFE-TIME

PURPOSE:

Define how a crack growth analysis of the failure probability is performed.

PARAMETERS:

ANALYSIS-METHOD	Use FORM or SORM (Parabolic) for the analysis, or use the DEFAULT method selected by the command SELECT ANALYSIS-METHOD PROBABILITY-ANALYSIS.
IMPORTANCE-FACTORS ON/OFF	Disable (OFF) or enable (ON) calculation of importance factors (in order to save computation time). This setting overrides the DEFINE ANALYSIS-OPTION IMPORTANCE command for crack growth analysis of the failure probability.
NUMBER-OF-TIME-STEPS nstep	The number of steps used to map the probability as a function of time over the whole service life. If the analysis is run over a shorter period, the number of steps is reduced according to the length of time covered.
PARAMETRIC-SENSITIVITY ON/OFF	Disable (OFF) or enable (ON) calculation of parametric sensitivities (in order to save computation time). This setting overrides the DEFINE ANALYSIS-OPTION SENSITIVITY command for crack growth analysis of the failure probability.

RUN-ANALYSIS-TO	Run each analysis to the end of the service life or to the next inspection. The latter is the default, and the former is the most time.
MAX-NO.-OF-LATEST-INSPECTIONS	The maximum number of latest inspections included in a run. The purpose is to reduce the amount of calculation by including only the number of latest inspections that has significance to the calculated reliability. Often the three latest inspections suffice, but this must be jugded on a case to case basis.
ninsp	The number of latest inspections included in an analysis.
ANNUAL-OR-LIFE-TIME-PROBABILITY	The type of analysis.
ANNUAL	Calculate annual failure probability.
LIFE-TIME	Calculate life time failure probability.

NOTES:

See also:

- RUN CRACK-GROWTH-ANALYSIS
- DISPLAY CRACK-GROWTH-ANALYSIS
- PRINT CRACK-GROWTH-ANALYSIS
- DEFINE PRESENTATION CRACK-GROWTH-ANALYSIS

EXAMPLE:

The following values are default when the program starts up with a new database:

```
DEFINE CRACK-GROWTH-ANALYSIS FAILURE-PROB ANALYSIS-METHOD FORM
DEFINE CRACK-GROWTH-ANALYSIS FAILURE-PROB IMPORTANCE FACTORS OFF
DEFINE CRACK-GROWTH-ANALYSIS FAILURE-PROB NUMBER-OF-STEPS 10
DEFINE CRACK-GROWTH-ANALYSIS FAILURE-PROB PARAMETRIC-SENSITIVITY OFF
DEFINE CRACK-GROWTH-ANALYSIS FAILURE-PROB RUN-ANALYSIS-TO INSPECTION
DEFINE CRACK-GROWTH-ANALYSIS FAILURE-PROB MAX-NO.-OF-LATEST-INSPECTIONS 200
DEFINE CRACK-GROWTH-ANALYSIS FAILURE-PROB ANNUAL-OR-LIFE-TIME-PROBABILITY
                                          LIFE-TIME
```

DEFINE CUTOFF-PD6493

...	CUTOFF-PD6493	value

PURPOSE:

Define the cut off value for PD6493.

PARAMETERS:

Value Recommended 0.15mm. Convert here to your own units.

NOTES:

1 The PD6493 weld magnification curve is not valid at the surface. The NPD (Norwegian Petroleum Directorate) recommendation is to use the value at 0.15mm below the surface for depths closer to surface. This value must be converted to the units operated in by the user.

2 The value is initialised to zero. If PD6493 is used in an analysis and the value is not positive, the analysis is aborted. The value must thus be set by the user.

EXAMPLE:

```
DEFINE CUTOFF-PD6493 0.15
```

DEFINE DISTRIBUTION-SIMULATION

...	DISTRIBUTION-SIMULATION	MONTE-CARLO-SIMULATION	nsim
		LATIN-HYPERCUBE-SIMULATION	nsim
		RESET	

PURPOSE:

Define analysis options for simulation of distributions.

PARAMETERS:

MONTE-CARLO-SIMULATION	Define Monte Carlo simulation of distributions.
LATIN-HYPERCUBE-SIMULATION	Define Latin Hypercube simulation of distributions.
nsim	The number of samples to be executed.
RESET	Reset all values and options to the default values used when initialising a new database.

NOTES:

The current analysis settings may be printed by use of the PRINT ANALYSIS-SETTINGS command.

See also:

- SELECT ANALYSIS-METHOD DISTRIBUTION-ANALYSIS
- PRINT ANALYSIS-SETTINGS
- RUN DISTRIBUTION-ANALYSIS

EXAMPLE:

The following values are default when the program starts up with a new database:

```
DEFINE DISTRIBUTION-SIMULATION MONTE-CARLO-SIMULATION 1000
DEFINE DISTRIBUTION-SIMULATION LATIN-HYPERCUBE-SIMULATION 100
```

DEFINE FATIGUE-CONSTANTS

...	FATIGUE-CONSTANTS	IN-PLANE-FACTOR	Fipb
		OUT-OF-PLANE-FACTOR	Fopb

PURPOSE:

Define constants applied to SCFs read from a Framework database.

PARAMETERS:

IN-PLANE-FACTOR Fipb	Correction factor applied for the in plane bending SCF at hotspots 4, 10, 16 and 22, only for PIPE elements and if the SCF distribution is either CROWN-SADDLE or PARAMETRIC.
OUT-OF-PLANE-FACTOR Fopb	Correction factor applied for the out of plane bending SCF, as above.

NOTES:

1 The factors are applied when a fatigue point located on a structure analysed in Framework is created, and the corresponding SCF values are created. Once the fatigue point is created, these factors no longer have any effect on SCF values for this point.

2 This command is only available when a Framework database is used.

3 Please be careful with applying factors less than 1.0 as this can be in conflict with the underlying theory.

See also:

- CREATE FATIGUE-POINT
- ASSIGN SCF

EXAMPLE:

The default values are set when running Framework.

```
DEFINE FATIGUE-CONSTANTS IN-PLANE-FACTOR 1.0
DEFINE FATIGUE-CONSTANTS OUT-OF-PLANE-FACTOR 1.0
```

DEFINE FORM-SORM

<table>
<tr><td rowspan="20">...</td><td rowspan="20">FORM-SORM</td><td rowspan="2">BOUNDS</td><td colspan="2">ON</td></tr>
<tr><td colspan="2">OFF</td></tr>
<tr><td colspan="2" rowspan="2">INACTIVE-CONSTRAINTS</td><td>ON</td></tr>
<tr><td>OFF</td></tr>
<tr><td colspan="2" rowspan="2">IMPORTANCE-FACTORS</td><td>ON</td></tr>
<tr><td>OFF</td></tr>
<tr><td colspan="2" rowspan="2">MULTINORMAL</td><td>SQP</td></tr>
<tr><td>CRUDE</td></tr>
<tr><td rowspan="4">OPTIMIZATION</td><td>SQP</td><td>maxit, maxstep, conv</td></tr>
<tr><td>NLPQL</td><td>...</td></tr>
<tr><td>RFCRC</td><td>...</td></tr>
<tr><td>RSM</td><td>...</td></tr>
<tr><td rowspan="3">SENSITIVITY</td><td rowspan="2">ANALYTICAL</td><td>ONE-WAY</td></tr>
<tr><td>TWO-WAY</td></tr>
<tr><td colspan="2">ASYMPTOTIC</td></tr>
<tr><td rowspan="4">STARTING-POINT</td><td rowspan="2">INITIAL</td><td>ASSIGNED</td></tr>
<tr><td>DEFAULT</td></tr>
<tr><td rowspan="2">PARAMETER-STUDY</td><td>PREVIOUS-SOLUTION</td></tr>
<tr><td>SAME-AS-INITIAL</td></tr>
<tr><td colspan="3">RESET</td></tr>
</table>

PURPOSE:

Define FORM/SORM analysis options.

PARAMETERS:

BOUNDS	Control the usage of bounds in probability calculation in a large intersection. If ON, bounds are used. If OFF, the probability is calculated using the multinormal distribution on the complementary set.
on/off	One of the alternatives: ON and OFF

INACTIVE-CONSTRAINTS	Control linearisation of constraints, that are inactive initially. If ON, such constraints are also linearised. If OFF, they are not linearised.
MULTINORMAL	Controls how the probability is calculated through the multinormal distribution. The SQP option is the most accurate. The CRUDE option should only be used if the SQP option fails.
OPTIMISATION	Selection of the optimization algorithm. Currently, only one algorithm is available.
SQP	Sequential quadratic programming.
maxit	The maximal number of iterations allowed.
maxstep	The maximal number of steps in one search direction.
conv	Convergence criterion.
NLPQL	Sequential quadratic programming. Extended options set. See DEFINE ... NLPQL
RFCRC	Robusted Rackwitz-Fiessler method. See DEFINE ... RFCRC.
RSM	Response surface method. See DEFINE ...RSM.
SENSITIVITY	Controls the method used to calculate parametric sensitivities and importance factors. ANALYTICAL calculation is exact for the FORM result, but requires a number of differentiations. ASYMPTOTIC calculation is quick, but not as accurate. The second order derivations using the ANALYTICAL calculation may be done ONE-WAY or TWO-WAY (to gain accuracy).
STARTING-POINT INITIAL	Controls the usage of the starting point in the FORM/SORM optimization. In a parameter study, it applies to the first analysis, as well as any other analysis where the previous solution is not used. The starting point can be either ASSIGNED (see ASSIGN STARTING-POINT) or DEFAULT. The default starting point is a small shift from the origin in U-space.
STARTING-POINT PARAMETER-STUDY	Controls the usage of starting points in a parameter study. Either the PREVIOUS-SOLUTION is used whenever possible, or the starting point is defined as above (SAME-AS-INITIAL).
RESET	Reset all values and options to the default values used when initialising a new database.

NOTES:

The current analysis settings may be printed by use of the PRINT ANALYSIS-SETTINGS command.

See also:

- ASSIGN STARTING-POINT
- DEFINE ANALYSIS-OPTION
- PRINT ANALYSIS-SETTINGS
- SELECT ANALYSIS-METHOD PROBABILITY-ANALYSIS

EXAMPLE:

The following values are default when the program starts up with a new database:

```
DEFINE FORM-SORM BOUNDS OFF
DEFINE FORM-SORM INACTIVE-CONSTRAINTS ON
DEFINE FORM-SORM MULTINORMAL SQP
DEFINE FORM-SORM OPTIMIZATION SQP 40 10 0.0025
DEFINE FORM-SORM SENSITIVITY ANALYTICAL ONE-WAY
DEFINE FORM-SORM STARTING-POINT INITIAL ASSIGNED
DEFINE FORM-SORM STARTING-POINT PARAMETER-STUDY PREVIOUS-SOLUTION
```

DEFINE ... NLPQL

...	NLPQL	search method	maxit	maximum step lenght	maxfun	conv	cnsv	bestpoint

PURPOSE:

Options for NLPQL.

PARAMETERS:

search method	One of BFGS and STEEPEST-DESCENT. BFGS generates a quadratic approximation to the function optimised on. STEEPEST-DESCENT generates a sequential linear approximation and is the more robust method when the gradients have poor numerical quality.
maxit	Maximum number of general iterations (gradient evaluations.)
maximum step length	FREE (limited by optimisation bounds) or VALUE. The value is the maximum steplength during one iteration. Prevents overshooting.
maxfun	Maximum number of function evaluations in line search for step length that improves merit function.
conv	Kuhn-Tucker optimality criterion.
cnsv	Test for constraint violation. ON-DEFAULT uses the square root of conv as test value. ON-USER uses a user specified value as test value. OFF skips the constraint value test.
bestpoint	ON delivers the best point reached during optimisation even if a convergency criterion is not met. OFF delivers a point that necessarily fulfils the convergency criteria.

NOTES:

The current analysis settings may be printed by use of the PRINT ANALYSIS-SETTINGS command.

See also:

- PRINT ANALYSIS-SETTINGS

EXAMPLES:

The following values are default when the program starts up with a new database:

```
DEFINE FORM-SORM OPTIMIZATION NLPQL BFGS 40 VALUE 5.0 10 0.0025 ON-DEFAULT OFF
```

DEFINE ... RFCRC

...	RFCRC	method	maxit	conv	test

PURPOSE:

Options for RFCRC.

PARAMETERS:

method	One of RF (Racwitz-Fiessler method) and RFCRC (Rackwitz-Fiessler method robusted with circle steps.)
maxit	Maximum number of general iterations (gradient evaluations.)
conv	Optimality criterion. Test for the U-space distance between the two last iterates.
test	Progress test. If RFstep(i+1) suggested by the algorithm is less than RFstep(i)/test, then accept the step, else proceed with a circle step.

NOTES:

A RF step is performed initially. Then the next step suggested by the RF method is examined. If the progress is unsatisfactory, then a circle step is performed. This step defines a u-space circle with center at u=0 and passing through the current iteration point in the plane defined by the u-space gradient at that point. The minimum point, um, of the event function, g(u), on this circle is found and an iteration is performed on the line from 0 to um to find g(unext)=0.

The method is restricted to a single event.

The analysis settings may be printed by use of the PRINT ANALYSIS-SETTINGS command.

See also:

- PRINT ANALYSIS-SETTINGS

EXAMPLES:

The following values are default when the program starts up with a new database:

```
DEFINE FORM-SORM OPTIMIZATION RFCRC CIRCLE 40 0.001 4.0
```

DEFINE MEAN-VALUE-FORM

<table>
<tr><td rowspan="6">...</td><td rowspan="6">MEAN-VALUE-FORM</td><td>POINTS</td><td>number</td></tr>
<tr><td>LOWER-PROBABILITY</td><td>lower</td></tr>
<tr><td>UPPER-PROBABILITY</td><td>upper</td></tr>
<tr><td rowspan="2">GRADIENT</td><td>ONE</td></tr>
<tr><td>THREE</td></tr>
<tr><td colspan="2">RESET</td></tr>
</table>

PURPOSE:

Define Mean value based FORM analysis options.

PARAMETERS:

POINTS number	The number of points to be calculated. These are spaced equally in distance in U-space, from the distance corresponding to lower to the distance corresponding to upper.
LOWER-PROBABILITY lower	The lower probability bound for the range in which values are calculated. Must be positive and less than 1.
UPPER-PROBABILITY upper	The upper probability bound for the range in which values are calculated. Must be positive and less than 1.
GRADIENT	The method uses either ONE gradient (at the origin of U-space) or THREE gradients (the remaining two are calculated at the lower and upper bound).
RESET	Reset all values and options to the default values used when initialising a new database.

NOTES:

The current analysis settings may be printed by use of the PRINT ANALYSIS-SETTINGS command.

See also:

- PRINT ANALYSIS-SETTINGS
- SELECT ANALYSIS-METHOD DISTRIBUTION-ANALYSIS

EXAMPLE:

The following values are default when the program starts up with a new database:

```
DEFINE MEAN-VALUE-FORM POINTS 19
```

```
DEFINE MEAN-VALUE-FORM LOWER-PROBABILITY 0.01
DEFINE MEAN-VALUE-FORM UPPER-PROBABILITY 0.99
DEFINE MEAN-VALUE-FORM GRADIENT ONE
```

DEFINE PARAMETER-STUDY

...	PARAMETER-STUDY	parameter	{value}*

PURPOSE:

Define parameter study values of a fixed variable or of a numerical parameter in a distribution or of a numerical argument in a function.

PARAMETERS:

parameter	The name of a fixed variable or the name of a numerical parameter in a distribution or of a numerical argument in a function.
value	Those parameter values for which the parameter study is to be performed.

NOTES:

1 A parameter study may be modified by entering the command again and selecting the same parameter. The current values are then presented as defaults.

2 Usage of the parameter study is controlled by the command DEFINE ANALYSIS-OPTION PARAMETER-STUDY.

See also:

- DEFINE ANALYSIS-OPTION PARAMETER-STUDY
- PRINT PARAMETER-STUDY
- PRINT RESULT PARAMETER-STUDY
- DISPLAY RESULT PARAMETER-STUDY

EXAMPLES:

```
DEFINE PARAMETER-STUDY XX-abc ( ONLY 22 24 25 29.6 )
DEFINE PARAMETER-STUDY StrCorr GROUP 0.1 0.9 0.1
```

DEFINE PLAN-INSPECTION

<table>
<tr><td rowspan="8">...</td><td rowspan="8">PLAN-INSPECTION</td><td rowspan="2">METHOD</td><td colspan="2">PRESCRIBED-TIMES</td><td colspan="2">{Time}*</td></tr>
<tr><td colspan="2">OPTIMISED-TIMES</td><td>conv</td><td>maxit</td></tr>
<tr><td colspan="2" rowspan="3">MONITOR-CALCULATION</td><td colspan="3">OFF</td></tr>
<tr><td colspan="3">ON</td></tr>
<tr><td colspan="3">ALL</td></tr>
<tr><td colspan="2" rowspan="2">KEEP-INSPECTIONS</td><td colspan="3">OFF</td></tr>
<tr><td colspan="3">ON</td></tr>
<tr><td colspan="3">MAX-NO.-OF-LATEST-INSPECTIONS</td><td colspan="2">ninsp</td></tr>
</table>

PURPOSE:

Define how an inspection plan is executed.

PARAMETERS:

METHOD	Specify planning method.
PRESCRIBED-TIMES	Inspect only at prescribed times.
time	The prescribed time points at which inspection is possible.
OPTIMISED-TIMES	Inspect each point when it is optimal, i.e. when the reliability threshold has been reached.
conv	The difference between target and actual reliability index is used as stop criterion.
maxit	The maximum number of iterations.
MONITOR-CALCULATION	Specify monitoring of the calculation of reliability indexes. OFF: Do not monitor calculations. ON: Monitor calculations presenting one line for each reliability. ALL: Full monitoring of Profast calculations.
KEEP INSPECTIONS	Specify what to do with predicted inspections created during the planning process. OFF: Delete planned inspections when the planning is done. ON: Keep planned inspections.
MAX-NO.-OF-LATEST-INSPECTIONS	The maximum number of latest inspections included in a run. The purpose is to reduce the amount of calculation by including only the number of latest inspections that has significance to the calculated reliability. Often the three latest inspections suffice, but this must be jugded on a case to case basis.

ninsp The number of latest inspections included in an analysis.

NOTES:

1 Keeping planned inspections allows a crack growth calculation to be performed showing the predicted reliability curve during the service life.

2 When a plan is deleted, all inspections created by the plan will be deleted.

See also:

- RUN PLAN-INSPECTION
- DEFINE CRACK-GROWTH-ANALYSIS

EXAMPLE:

The following values are default when the program starts up with a new database:

```
DEFINE PLAN-INSPECTION OPTIMISED-TIMES 0.01 10
DEFINE PLAN-INSPECTION MONITOR-CALCULATION OFF
DEFINE PLAN-INSPECTION KEEP-INSPECTIONS OFF
DEFINE PLAN-INSPECTION MAX-NO.-OF-LATEST-INSPECTIONS 200
```

DEFINE PRESENTATION

...	PRESENTATION	CRACK-GROWTH-ANALYSIS	...
		FUNCTION	
		RESULT	
		TRANSFER-FUNCTION	

PURPOSE:

Define presentation of results and input data.

PARAMETERS:

CRACK-GROWTH-ANALYSIS	Define presentation of crack growth analysis results.
FUNCTION	Define presentation of model functions.
RESULT	Define presentation of analysis results.
TRANSFER-FUNCTION	Define presentation of transfer functions.

NOTES:

None.

DEFINE PRESENTATION CRACK-GROWTH-ANALYSIS

...	CRACK-GROWTH-ANALYSIS	SN-FAILURE-CURVE	OFF
			ON

PURPOSE:

Define presentation of crack growth analysis results.

PARAMETERS:

SN-FAILURE-CURVE Specify if the SN failure curve shall be included (when available) in the display of the crack growth analysis failure curve. OFF: Do not include the SN failure curve. ON: Include the SN failure curve.

NOTES:

See also:

- RUN SN-ANALYSIS FAILURE-PROBABILITY
- RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY
- DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY

EXAMPLES:

The default at program start-up is:

```
DEFINE PRESENTATION CRACK-GROWTH-ANALYSIS SN-FAILURE-CURVE OFF
```

DEFINE PRESENTATION FUNCTION

...	FUNCTION	1D-FUNCTION-DISPLAY	nval
		2D-FUNCTION-DISPLAY	nx, ny

PURPOSE:

Define options for presentation of model functions

PARAMETERS:

1D-FUNCTION-DISPLAY nval	The number of function evaluations used in a one dimensional graph of a model function.
2D-FUNCTION-DISPLAY nx, ny	The number of abscissa (nx) and ordinate (ny) values used in a two dimensional display of a model function. The total number of function evaluations will be nx*ny.

NOTES:

See also:

- DISPLAY FUNCTION

EXAMPLE:

The following values are default when the program starts up with a new database:

```
DEFINE PRESENTATION FUNCTION 1D-FUNCTION-DISPLAY 101
DEFINE PRESENTATION FUNCTION 2D-FUNCTION-DISPLAY 21 21
```

DEFINE PRESENTATION RESULT

...	RESULT	CONFIDENCE-VALUE	conf
		IMPORTANCE-CUTOFF	cutoff
		IMPORTANCE-LIMIT	limit
		INTERMEDIATE-SIMULATIONS	intsim
		SENSITIVITY-MEASURE	inc, lim
		V-SPACE-POINT	ON
			OFF
		RESET	

PURPOSE:

Define options for presentation of results.

PARAMETERS:

CONFIDENCE-VALUE conf

The confidence value that is used with print and display of confidence limits. This value must be given in %, e.g. a value of 95 will print/display 95% confidence limits.

IMPORTANCE-CUTOFF cutoff

This value is used to cut off the smallest importance factor values from the print of importance factors. This value must be given in %, e.g. if input as 5, all importance factor values less than 5% will not be printed.

IMPORTANCE-LIMIT limit

This value is used to group the smallest importance factor values in the display of importance factors. This value must be given in %, e.g. if input as 5, all importance factor values less than 5% will be shown in one pie slice, named “Other”.

INTERMEDIATE-SIMULATIONS intsim

Determines how many lines of intermediate results will be printed with the PRINT RESULT ALL command after a simulation analysis. To see all intermediate simulation results, set intsim to a value equal to or greater than the number of samples performed.

SENSITIVITY-MEASURE inc, lim

Defines how sensitivity measures are calculated. A sensitivity measure is dimensionless, in that it measures the change in the target value when a parameter is multiplied by (1+inc). As this definition

	does not work when the parameter value is zero, lim denotes the smallest parameter value to which it can be applied.
V-SPACE-POINT	Defines if the V-space coordinates of a FORM linearisation point are to be printed (ON) or not (OFF).
RESET	Reset all values and options to the default values used when initialising a new database.

NOTES:

See also:

- PRINT RESULT
- DISPLAY RESULT

EXAMPLE:

The following values are default when the program starts up with a new database:

```
DEFINE PRESENTATION RESULT CONFIDENCE-VALUE 90
DEFINE PRESENTATION RESULT IMPORTANCE-CUTOFF 0
DEFINE PRESENTATION RESULT IMPORTANCE-LIMIT 5
DEFINE PRESENTATION RESULT INTERMEDIATE-SIMULATIONS 10
DEFINE PRESENTATION RESULT SENSITIVITY-MEASURE 0.1 0.0001
DEFINE PRESENTATION RESULT V-SPACE-POINT OFF
```

DEFINE PRESENTATION TRANSFER-FUNCTION

...	TRANSFER-FUNCTION	ORDINATE-VALUES	AMPLITUDE
			PHASE-AMPLITUDE
			REAL-IMAGNARY
		ABSCISSA-AXIS	ANGULAR-FREQUENCY
			PERIOD
			WAVE-LENGTH

PURPOSE:

Define presentation of transfer functions.

PARAMETERS:

ORDINATE-VALUES	Define how the ordinate is presented.
AMPLITUDE	Use the amplitude in the display of the transfer functions. This will allow display of more than one curve at the same time.
PHASE-AMPLITUDE	Use the phase and amplitude as ordinates in the display of the transfer function. This will generate two curves, and allows display of only one transfer function in one direction at a time.
REAL-IMAGINARY	Display the real and imaginary values as ordinates in the display of the transfer function. This will generate two curves, and allows display of only one transfer function in one direction at a time.
ABSCISSA-AXIS	Define how the abscissa is presented.
ANGULAR-FREQUENCY	Use angular frequencies along the abscissa axis.
PERIOD	Use the wave period along the abscissa axis.
WAVE-LENGTH	Use the wave length along the abscissa axis.

NOTES:

See Figure 3.7.

See also:

- CHANGE TRANSFER-FUNCTION
- CREATE TRANSFER-FUNCTION

- DISPLAY TRANSFER-FUNCTION
- PRINT TRANSFER-FUNCTION

EXAMPLES:

The default at program start-up is:

```
DEFINE PRESENTATION TRANSFER-FUNCTION ORDINATE-VALUES AMPLITUDE
DEFINE PRESENTATION TRANSFER-FUNCTION ABSCISSA-AXIS ANGULAR-FREQUENCY
```

DEFINE PROBABILITY-ANALYSIS

...	PROBABILITY-ANALYSIS	AXIS-ORTHOGONAL	...
		DESIGN-POINT	
		DIRECTIONAL	
		MONTE-CARLO	

PURPOSE:

Define analysis options that apply to simulation of a probability.

PARAMETERS:

AXIS-ORTHOGONAL	Define analysis options for axis orthogonal simulation.
DESIGN-POINT	Define analysis options for design point simulation.
DIRECTIONAL	Define analysis options for directional simulation.
MONTE-CARLO	Define analysis options for Monte Carlo simulation.

NOTES:

None

DEFINE PROBABILITY-SIMULATION AXIS-ORTHOGONAL

...	AXIS-ORTHOGONAL	COEFFICIENT-OF-VARIATION	cov
		CPU-TIME	cpu
		DENSITY	CONDITIONED
			STANDARD-NORMAL
		SEARCH	RISKY-AND-FAST
			MEDIUM-SAFE
			SAFE-AND-SLOW
		SIMULATIONS	nsim
		RESET	

PURPOSE:

Define analysis options for axis orthogonal simulation of a probability.

PARAMETERS:

COEFFICIENT-OF-VARIATION cov	The sampling will stop if the coefficient of variation of the simulated result becomes lower than or equal to cov. To disable this stop criterion, set cov to 0. cov must be non-negative.
CPU-TIME cpu	The sampling will stop when the cpu time cpu (in seconds) has been exceeded. The check is performed after each sample is completed. To disable this stop criterion, set cpu to 0. cpu must be non-negative.
DENSITY	Specifies the sampling density.
CONDITIONED	This density has a shape that is dependent on the shape of the limit state surface, and produces a result that is a multiplicative correction to the FORM probability. This is generally quite fast and accurate, but it depends on a reasonable FORM approximation to the limit state surface.
STANDARD-NORMAL	This density is not dependent on the shape of the limit state surface, and produces an additive correction to the FORM probability. This option is the slowest and safest of the two.
SEARCH	Specifies how the line search for points on the limit state surface is performed along the simulated direction.
RISKY-AND-FAST	This search method simply checks one point far out on the line, and looks for a solution only if the sign of the function is different at the origin and at the end point. This method is generally

	sufficient for single events. It is generally not recommended for analysis of other events.
MEDIUM-SAFE	This search method steps out to the first solution (if any), then takes one step to the end to see if there should be another solution. This method is sufficiently accurate in most cases.
SAFE-AND-SLOW	This search method steps out to the “end” of the line (where the probability becomes negligible) without skipping any larger pieces.
SIMULATIONS nsim	The simulation will stop after nsim samples has been completed. nsim must be a positive whole number.
RESET	Reset all values and options to the default values used when initialising a new database.

NOTES:

1 The current analysis settings may be printed by use of the PRINT ANALYSIS-SETTINGS command.

2 The simulation will run until any one of the stop criteria has been met.

3 Sensitivity calculation is not possible with this analysis method.

See also:

- PRINT ANALYSIS-SETTINGS
- SELECT ANALYSIS-METHOD PROBABILITY-ANALYSIS3

EXAMPLE:

The following values are default when the program starts up with a new database:

```
DEFINE PROBABILITY-ANALYSIS AXIS-ORTHOGONAL COEFFICIENT-OF-VARIATION 0
DEFINE PROBABILITY-ANALYSIS AXIS-ORTHOGONAL CPU-TIME 60
DEFINE PROBABILITY-ANALYSIS AXIS-ORTHOGONAL DENSITY CONDITIONED
DEFINE PROBABILITY-ANALYSIS AXIS-ORTHOGONAL SEARCH MEDIUM-SAFE
DEFINE PROBABILITY-ANALYSIS AXIS-ORTHOGONAL SIMULATIONS 50
```

DEFINE PROBABILITY-SIMULATION DESIGN-POINT

<table>
<tr><td rowspan="4">...</td><td rowspan="4">DESIGN-POINT</td><td>COEFFICIENT-OF-VARIATION</td><td>cov</td></tr>
<tr><td>CPU-TIME</td><td>cpu</td></tr>
<tr><td>SIMULATIONS</td><td>nsim</td></tr>
<tr><td colspan="2">RESET</td></tr>
</table>

PURPOSE:

Define analysis options for design point simulation of a probability.

PARAMETERS:

COEFFICIENT-OF-VARIATION cov	The simulations will stop if the coefficient of variation of the simulated result becomes lower than or equal to cov. To disable this stop criterion, set cov to 0. cov must be non-negative.
CPU-TIME cpu	The simulations will stop when the cpu time cpu (in seconds) has been exceeded. The check is performed after each simulation is completed. To disable this stop criterion, set cpu to 0. cpu must be non-negative.
SIMULATIONS nsim	The simulation will stop after nsim simulations has been completed. nsim must be a positive whole number.
RESET	Reset all values and options to the default values used when initialising a new database.

NOTES:

1 The design point simulation first finds the design point. Then it performs a Monte Carlo probability simulation with sampling density centered at the design point.

2 The current analysis settings may be printed by use of the PRINT ANALYSIS-SETTINGS command.

3 The simulation will run until any one of the stop criteria has been met.

4 Sensitivity calculation is not possible with this analysis method.

See also:

- PRINT ANALYSIS-SETTINGS
- SELECT ANALYSIS-METHOD PROBABILITY-ANALYSIS

EXAMPLES:

The following values are default when the program starts up with a new database:

```
DEFINE PROBABILITY-ANALYSIS DESIGN-POINT COEFFICIENT-OF-VARIATION 0
DEFINE PROBABILITY-ANALYSIS DESIGN-POINT CPU-TIME 60
DEFINE PROBABILITY-ANALYSIS DESIGN-POINT SIMULATIONS 1000
```

DEFINE PROBABILITY-SIMULATION DIRECTIONAL

...	DIRECTIONAL	COEFFICIENT-OF-VARIATION	cov	
		CPU-TIME	cpu	
		METHOD	DEFAULT	
			RANDOM-DIRECTION	
			ORTHOGONAL-1	
			ORTHOGONAL-2	
			ORTHOGONAL-3	
		SEARCH	RISKY-AND-FAST	
			MEDIUM-SAFE	
			SAFE-AND-SLOW	
		SEARCH-LIMIT	PROBABILITY	probvalue
			STANDARD-NORMAL	argvalue
		STEP-LENGTH	length	
		SIMULATIONS	nsim	
		RESET		

PURPOSE:

Define analysis options for directional simulation of a probability.

PARAMETERS:

COEFFICIENT-OF-VARIATION *cov*	The simulations will stop if the coefficient of variation of the simulated result becomes lower than or equal to *cov.* To disable this stop criterion, set *cov* to 0. The *cov* must be non-negative.
CPU-TIME *cpu*	The simulations will stop when the cpu time (in seconds) has been exceeded. The check is performed after each simulation is completed. To disable this stop criterion, set *cpu* to 0. The *cpu* must be non-negative.
METHOD	Specifies the sampling method.
DEFAULT	The default sampling method is selected on the basis of the dimension of the *u*-space. This method is recommended in most cases. If the model contains a time consuming model function, it may be better to use the random direction method.

RANDOM-DIRECTION	The probability is calculated in a simulated direction and in the opposite direction, and the average of the two probabilities is used as the sample probability. This reduces the sample variance because the two probabilities can be assumed to be negatively correlated. This is the simplest technique. It is mostly useful when the more sophisticated techniques take too long time to produce results.
ORTHOGONAL-1	An orthogonal set of directions, that span the *u*-space, is simulated. The probability is then found in each of these directions and their opposite directions, and the average value is calculated and used as the sample value. The sample variance is further reduced by this method. The drawback is that it may take some time to produce each sample value because of the large number of calculations involved.
ORTHOGONAL-2	Is a sophistication of the ORTHOGONAL-1 method. Instead of using the simulated directions and their opposites, all possible averages of two of these directions are used. This gives a better coverage of *u*-space, but increases computation time considerably.
ORTHOGONAL-3	As ORTHOGONAL-2, except that averages are formed of all possible combinations of three directions instead of two. This method can be very time consuming.
SEARCH	Specifies how the line search for points on the limit state surface is performed along the simulated direction.
RISKY-AND-FAST	This search method simply checks one point far out on the line, and looks for a solution only if the sign of the function is different at the origin and at the end point. This method is generally sufficient for single events. It is generally not recommended for analysis of other events.
MEDIUM-SAFE	This search method steps out to the first solution (if any), then takes one step to the end to see if there should be another solution. This method is sufficiently accurate in most cases.
SAFE-AND-SLOW	This search method steps out in the *u*-space to the “end” of the line (where the probability becomes negligible) without skipping any larger pieces.
SEARCH-LIMIT	The search method steps out in the *u*-space until the probability of the remaining line becomes negligible, as specified by the search limit. The search limit may be entered as a PROBABILITY with value *probval* or as a STANDARD-NORMAL *argval*, which is the *u*-space search limit. Notice the correspondence ($\Phi(-u)$=*probval*)
STEP-LENGTH *length*	The search method steps out in the *u*-space in search for zero points until the probability of the remaining line becomes

	negligible, as specified by the search limit. Starting from *u*=0, the next step is $u_{next} = u_{current} + length$.
SIMULATIONS *nsim*	The simulation will stop after *nsim* simulations has been completed. nsim must be a positive whole number.
RESET	Reset all values and options to the default values used when initialising a new database.

NOTES:

1 The current analysis settings may be printed by use of the PRINT ANALYSIS-SETTINGS command.

2 The simulation will run until any one of the stop criteria has been met.

See also:

- PRINT ANALYSIS-SETTINGS
- SELECT ANALYSIS-METHOD PROBABILITY-ANALYSIS

EXAMPLES:

The following values are default when the program starts up with a new database:

```
DEFINE PROBABILITY-ANALYSIS DIRECTIONAL COEFFICIENT-OF-VARIATION 0
DEFINE PROBABILITY-ANALYSIS DIRECTIONAL CPU-TIME 60
DEFINE PROBABILITY-ANALYSIS DIRECTIONAL METHOD DEFAULT
DEFINE PROBABILITY-ANALYSIS DIRECTIONAL SEARCH MEDIUM-SAFE
DEFINE PROBABILITY-ANALYSIS DIRECTIONAL SIMULATIONS 50
```

DEFINE PROBABILITY-SIMULATION MONTE-CARLO

...	MONTE-CARLO	COEFFICIENT-OF-VARIATION	cov
		CPU-TIME	cpu
		SIMULATIONS	nsim
		RESET	

PURPOSE:

Define analysis options for Monte Carlo simulation of a probability.

NOTES:

1 The current analysis settings may be printed by use of the PRINT ANALYSIS-SETTINGS command.

2 The simulation will run until any one of the stop criteria has been met.

3 Sensitivity calculation is not possible with this analysis method.

See also:

- PRINT ANALYSIS-SETTINGS
- SELECT ANALYSIS-METHOD PROBABILITY-ANALYSIS

EXAMPLE:

The following values are default when the program starts up with a new database:

```
DEFINE PROBABILITY-ANALYSIS MONTE-CARLO COEFFICIENT-OF-VARIATION 0
DEFINE PROBABILITY-ANALYSIS MONTE-CARLO CPU-TIME 60
DEFINE PROBABILITY-ANALYSIS MONTE-CARLO SIMULATIONS 1000
```

DEFINE SERVICE-LIFE

...	SERVICE-LIFE	start	final

PURPOSE:

Define the life time of the structure being analysed.

PARAMETERS:

start	Start time of the analysis, in years.
final	End time of the analysis, in years.

NOTES:

Times are is specified in decimal years, e.g. 1995.5 is the start of July 1995.

See also:

- ASSIGN UNCERTAINTY VALUE
- PRINT UNCERTAINTY
- PRINT ANALYSIS-SETTINGS

EXAMPLES:

The default at program start-up is:

```
DEFINE SERVICE-LIFE 0 25
```

DEFINE SN-ANALYSIS FAILURE-PROBABILITY

...	FAILURE-PROBABILITY	ANALYSIS-METHOD	FORM
			SORM
			DEFAULT
		IMPORTANCE-FACTORS	ON
			OFF
		NUMBER-OF-STEPS	nstep
		PARAMETRIC-SENSITIVITY	ON
			OFF

PURPOSE:

Define how an SN analysis of the failure probability is performed.

PARAMETERS:

ANALYSIS-METHOD	Use FORM or SORM (Parabolic) for the analysis, or use the DEFAULT method selected by the command SELECT ANALYSIS-METHOD PROBABILITY-ANALYSIS.
IMPORTANCE-FACTORS	Disable (OFF) or enable (ON).
	calculation of importance factors (in order to save computation time). This setting overrides the DEFINE ANALYSIS-OPTION IMPORTANCE command for crack growth analysis of the failure probability.
NUMBER-OF-STEPS nstep	The number of steps used to map the probability as a function of time over the whole service life.
PARAMETRIC-SENSITIVITY	Disable (OFF) or enable (ON) calculation of parametric sensitivities (in order to save computation time). This setting overrides the DEFINE ANALYSIS-OPTION SENSITIVITY command for crack growth analysis of the failure probability.

NOTES:

See also.

- RUN SN-ANALYSIS
- DISPLAY SN-ANALYSIS
- PRINT SN-ANALYSIS

EXAMPLE:

The following values are default when the program starts up with a new database:

```
DEFINE SN-ANALYSIS FAILURE-PROB ANALYSIS-METHOD FORM
DEFINE SN-ANALYSIS FAILURE-PROB IMPORTANCE-FACTORS OFF
DEFINE SN-ANALYSIS FAILURE-PROB NUMBER-OF-STEPS 10
DEFINE SN-ANALYSIS FAILURE-PROB PARAMETRIC-SENSITIVITY OFF
```

DEFINE TRANSFER-FUNCTION

...	TRANSFER-FUNCTION	INTERPOLATION	LINEAR
			QUADRATIC
			CUBIC

PURPOSE:

Define the usage of transfer functions.

PARAMETERS:

INTERPOLATION Define the interpolation method to be used during calculation of a transfer function value: LINEAR, QUADRATIC or CUBIC interpolation.

NOTES:

The quadratic and cubic options may cause some instability in the calculation of the Sum-Rayleigh distribution.

See also.

- ASSIGN STRESS-RANGE

EXAMPLES:

The default at program start-up is:

```
DEFINE TRANSFER-FUNCTION INTERPOLATION LINEAR
```

DEFINE UNCERTAINTY

...	UNCERTAINTY	parameter	distribution	DEFAULT	...

...	lower, upper, lowCoV, medCoV, HigCoV, lowStD, medStDHigStD

PURPOSE:

Define the default uncertainty for a stochastic parameter.

PARAMETERS:

parameter — A parameter name.

distribution — Default distribution for the parameter. The mean value of the distribution will be input as the parameter value when the default distribution is used. Mpost distributions require in addition an uncertainty definition. In this case, this is defined through the remaining six values as LOW, MEDIUM and HIGH uncertainty values. If no uncertainty is required (e.g. for the Exponential distribution), these values need not be input.

DEFAULT — The default uncertainty to be used when a new parameter is created based on this definition. One of NONE, KNOWN if the standard deviation is a function of the mean value, and one of NONE, LOW, MEDIUM, HIGH otherwise.

lower — Lower bound for the distribution, when applicable.

upper — Upper bound for the distribution, when applicable.

lowCoV — The Coefficient of Variation to be applied as LOW uncertainty.

medCoV — The Coefficient of Variation to be applied as MEDIUM uncertainty.

higCoV — The Coefficient of Variation to be applied as HIGH uncertainty.

lowStD — The Standard Deviation to be applied as LOW uncertainty.

medStD — The Standard Deviation to be applied as MEDIUM uncertainty.

higStD — The Standard Deviation to be applied as HIGH uncertainty.

NOTES:

1 The Coefficient of Variation is defined in this case as the standard deviation divided by the absolute value of the mean.

2 When defining the uncertainty based on the user input, the coefficient of variation is applied unless it generates an uncertainty lower than the corresponding standard deviation. In this case, the standard devi-

ation is used. Thus the uncertainty can never be less than the standard deviation, and will grow with the mean value when CoV * Abs(Mean) becomes larger than the standard deviation.

3 When an uncertainty definition is changed, all stochastic parameters based on this definition will be updated to reflect the new definition.

4 The current setting can be printed using the command PRINT UNCERTAINTY-DEFINITION.

See also.

- ASSIGN UNCERTAINTY VALUE
- PRINT UNCERTAINTY

EXAMPLES:

```
DEFINE UNCERTAINTY FatigPnt-lnC LOGNORMAL NONE 0.01 0.05 0.2 0.01 0.05 0.2
```

DEFINE WEIBULL-FIT

<table>
<tr><td rowspan="4">...</td><td rowspan="4">WEIBULL-FIT</td><td>DETERMINISTIC</td><td>{prob}*</td></tr>
<tr><td rowspan="3">PROBABILISTIC</td><td>prob1, fac11, fac12</td></tr>
<tr><td>prob2, fac21, fac22</td></tr>
<tr><td>prob3, fac31, fac32</td></tr>
</table>

PURPOSE:

Define probability and stress values at which a Weibull stress range fit is performed.

PARAMETERS:

DETERMINISTIC	Define probability values for a deterministic Weibull fit.
prob	Cumulative probabilities, used to define fractile stress values at which the distribution is fitted. At least two values must be specified.
PROBABILISTIC	Define probability values for a probabilistic Weibull fit.
prob1, prob2, prob3	Cumulative probability values, used to define fractiles at which a probabilistic fit is performed.
fac11 ... fac32	Factors on the stress values at which the probabilistic analyses are performed. faci1 and faci2 are used together with probi.

NOTES:

See also.

- ASSIGN STRESS-RANGE

EXAMPLES:

The defaults at program start-up is:

```
DEFINE WEIBULL-FIT DETERMINISTIC ( ONLY 0.5 0.825 0.9 0.937 0.96 0.975 0.985 0.991
0.996 0.999 0.9999 )
DEFINE WEIBULL-FIT PROBABILISTIC 0.921 1.0 1.2 0.975 1.0 1.2 0.994 1.0 1.2
```

DELETE

DELETE	EVENT	...
	FATIGUE-POINT	...
	FUNCTION	...
	INSPECTION	...
	PLAN-INSPECTION	...
	RESULT	...
	SN-CURVE	...
	TRANSFER-FUNCTION	...
	VARIABLE	...
	WAVE-SPREADING-FUNCTION	...
	WAVE-STATISTICS	...

PURPOSE:

Delete a named object.

PARAMETERS:

EVENT	Delete an event.
FATIGUE-POINT	Delete a fatigue point.
FUNCTION	Delete a function formula or a function integral.
INSPECTION	Delete an inspection.
PLAN-INSPECTION	Delete an inspection plan.
RESULT	Delete an analysis result.
SN-CURVE	Delete an SN curve.
TRANSFER-FUNCTION	Delete a transfer function.
VARIABLE	Delete a random variable.
WAVE-SPREADING-FUNCTION	Delete a wave spreading function.
WAVE-STATISTICS	Delete a wave statistics formulation.

NOTES:

None.

DELETE EVENT

...	EVENT	name+

PURPOSE:

Delete one or more events.

PARAMETERS:

name+ Name(s) of the event(s) to be deleted.

NOTES:

Deletion cannot be undone. The only way to undo a deletion is to edit the command(s) generating the deleted object from the journal file, and then read the command input file into the program again.

See also.

- CREATE EVENT
- CHANGE EVENT
- COPY EVENT
- RENAME EVENT
- DISPLAY EVENT
- PRINT EVENT

EXAMPLES:

```
DELETE EVENT PFC*
```

DELETE FATIGUE-POINT

...	FATIGUE-POINT	name+

PURPOSE:

Delete one or more fatigue points.

PARAMETERS:

name+ Name(s) of fatigue point(s) to be deleted.

NOTES:

Deletion cannot be undone. The only way to undo a deletion is to edit the command(s) generating the deleted object from the journal file, and then read the command input file into the program again.

See also.

- CREATE FATIGUE-POINT
- PRINT FATIGUE-POINT

EXAMPLES:

```
DELETE FATIGUE-POINT C35
```

DELETE FUNCTION

...	FUNCTION	name+

PURPOSE:

Delete one or more function formulas or function integrals.

PARAMETERS:

name+ Name(s) of the function(s) to be deleted.

NOTES:

Deletion cannot be undone. The only way to undo a deletion is to edit the command(s) generating the deleted object from the journal file, and then read the command input file into the program again.

See also:

- CREATE FUNCTION
- CHANGE FUNCTION
- RENAME FUNCTION
- DISPLAY FUNCTION
- PRINT FUNCTION

EXAMPLES:

```
DELETE FUNCTION SYMFUN
```

DELETE INSPECTION

...	INSPECTION	name+

PURPOSE:

Delete one or more inspections.

PARAMETERS:

name+	Name(s) of the inspection(s) to be deleted.

NOTES:

1 Deletion cannot be undone. The only way to undo a deletion is to edit the command(s) generating the deleted object from the journal file, and then read the command input file into the program again.

2 When an inspection is deleted, all assignments to the inspection are also deleted.

See also.

- CREATE INSPECTION
- PRINT INSPECTION

EXAMPLES:

```
DELETE INSPECTION P1S-*
```

DELETE PLAN-INSPECTION

...	PLAN-INSPECTION	name+

PURPOSE:

Delete one or more results from an inspection plan analysis.

PARAMETERS:

name+	Name(s) of the inspection plan(s) to be deleted.

NOTES:

1 Deletion cannot be undone. The only way to undo a deletion is to edit the command(s) generating the deleted object from the journal file, and then read the command input file into the program again.

2 When an inspection plan is deleted, all inspections generated by the plan are also deleted.

See also.

- RUN PLAN-INSPECTION
- PRINT PLAN-INSPECTION

EXAMPLES:

```
DELETE PLAN-INSPECTION BRAGE3
```

DELETE RESULT

...	RESULT	name+

PURPOSE:

Delete one or more results.

PARAMETERS:

name+ Name(s) of the result(s) to be deleted.

NOTES:

1 Deletion cannot be undone. The only way to undo a deletion is to edit the command(s) generating the deleted object from the journal file, and then read the command input file into the program again.

2 Those results created by this program should not be deleted by the user.

See also.

- RUN PROBABILITY-ANALYSIS
- RUN DISTRIBUTION-ANALYSIS
- SAVE RESULT
- DISPLAY RESULT
- PRINT RESULT

EXAMPLES:

```
DELETE RESULT Prob*
```

DELETE SN-CURVE

...	SN-CURVE	name+

PURPOSE:

Delete one or more SN curves.

PARAMETERS:

name+ Name(s) of SN-curve(s) to be deleted.

NOTES:

1 Deletion cannot be undone. The only way to undo a deletion is to edit the command(s) generating the deleted object from the journal file, and then read the command input file into the program again.

2 Predefined SN-curves cannot be deleted.

See also.

- CREATE SN-CURVE
- DISPLAY SN-CURVE
- PRINT SN-CURVE

EXAMPLES:

```
DELETE SN-CURVE USER*
```

DELETE TRANSFER-FUNCTION

...	TRANSFER-FUNCTION	name+

PURPOSE:

Delete one or more transfer functions.

PARAMETERS:

name+	Name(s) of transfer function(s) to be deleted.

NOTES:

Deletion cannot be undone. The only way to undo a deletion is to edit the command(s) generating the deleted object from the journal file, and then read the command input file into the program again.

See also.

- CREATE TRANSFER-FUNCTION
- DISPLAY TRANSFER-FUNCTION
- PRINT TRANSFER-FUNCTION

EXAMPLES:

```
DELETE TRANSFER-FUNCTION USER*
```

DELETE VARIABLE

...	VARIABLE	name+

PURPOSE:

Delete one or more variables.

PARAMETERS:

name+ Name(s) of the variable(s) to be deleted.

NOTES:

1 Deletion cannot be undone. The only way to undo a deletion is to edit the command(s) generating the deleted object from the journal file, and then read the command input file into the program again.

2 If a deleted variable is used in a single event, the single event is also deleted.

See also.

- CREATE VARIABLE
- CHANGE VARIABLE
- COPY VARIABLE
- RENAME VARIABLE
- DISPLAY VARIABLE
- PRINT VARIABLE

EXAMPLES:

```
DELETE VARIABLE X*
```

DELETE WAVE-SPREADING-FUNCTION

...	WAVE-SPREADING-FUNCTION	name+

PURPOSE:

Delete one or more wave spreading functions.

PARAMETERS:

name+ Name(s) of wave spreading function(s) to be deleted.

NOTES:

Deletion cannot be undone. The only way to undo a deletion is to edit the command(s) generating the deleted object from the journal file, and then read the command input file into the program again.

See also.

- CREATE WAVE-SPREADING-FUNCTION
- DISPLAY WAVE-SPREADING-FUNCTION
- PRINT WAVE-SPREADING-FUNCTION

EXAMPLES:

```
DELETE WAVE-SPREADING-FUNCTION SPR*
```

DELETE WAVE-STATISTICS

...	WAVE-STATISTICS	name+

PURPOSE:

Delete one or more wave statistics.

PARAMETERS:

name+ Name(s) of wave statistics to be deleted.

NOTES:

Deletion cannot be undone. The only way to undo a deletion is to edit the command(s) generating the deleted object from the journal file, and then read the command input file into the program again.

See also.

- CREATE WAVE-STATISTICS
- DISPLAY WAVE-STATISTICS
- PRINT WAVE-STATISTICS

EXAMPLES:

```
DELETE WAVE-STATISTICS SCAT?
```

DISPLAY

DISPLAY	CALIBRATION-CRACK-GROWTH	...
	CRACK-GROWTH-ANALYSIS	...
	DISTRIBUTION	...
	EVENT	...
	FUNCTION	...
	FITTED-DISTRIBUTION	...
	GEOMETRY-FUNCTION	...
	JOINT	...
	LABEL	...
	MEMBER	...
	PRESENTATION	...
	RESULT	...
	SN-ANALYSIS	...
	SN-CURVE	...
	STRESS-RANGE	...
	SUPERELEMENT	...
	TRANSFER-FUNCTION	...
	WAVE-SPREADING-FUNCTIO	...
	WELD-EFFECT	...

PURPOSE:

To present input data and results graphically.

PARAMETERS:

CALIBRATION-CRACK-GROWTH	Display the result of a crack growth model calibration.
CRACK-GROWTH-ANALYSIS	Display the result of a crack growth analysis.
DISTRIBUTION	Display the distribution of random variable(s).
EVENT	Display an event.
FUNCTION	Display a model function.
FITTED-DISTRIBUTION	Display a fitted the distribution with input data.

GEOMETRY-FUNCTION	Display an assigned geometry function.
JOINT	Display one or more joints.
LABEL	Turns display of labels on/off.
MEMBER	Display one or more members.
PRESENTATION	Switch between wire frame and hidden surface display.
RESULT	Display an analysis result.
SN-ANALYSIS	Display the result of an SN analysis.
SN-CURVE	Display one or more SN curves.
STRESS-RANGE	Display the distribution of the stress range.
TRANSFER-FUNCTION	Display one or more transfer functions.
SUPERELEMENT	Display the finite element model for the current superelement.
WAVE-SPREADING-FUNCTION	Display a wave spreading function.
WELD-EFFECT	Display an assigned weld effect.

NOTES:

1 Display of joints and members require access to a Framework database.

2 Display of a superelement requires access to a SIN file.

3 Display of results will only be available when the results exist.

DISPLAY CALIBRATION-CRACK-GROWTH

...	CALIBRATION-CRACK-GROWTH	fatigpnt/inspect	FINAL
			START-AND-FINAL
			ALL-ITERATIONS

PURPOSE:

Display the result of a calibration of the crack growth model to the SN reliability result.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection for which the calibration was made.
FINAL	Display the final result only (SN reliability indexes and crack growth reliabilitity indexes).
START-AND-FINAL	Display the initial crack growth reliability indexes together with the final result.
ALL-ITERATIONS	Display all iterations together with the starting point and the final result.

NOTES:

Examples of the display can be seen in Figure 2.6 and Figure 3.14.

See also.

- RUN CALIBRATION-CRACK-GROWTH
- PRINT CALIBRATION-CRACK-GROWTH
- SET GRAPH

EXAMPLE:

```
DISPLAY CALIBRATION-CRACK-GROWTH C3501 START-AND-FINAL
```

DISPLAY CRACK-GROWTH-ANALYSIS

...	CRACK-GROWTH-ANALYSIS	FAILURE-PROBABILITY	...
		LIFE-TIME	

PURPOSE:

Display the result of a crack growth analysis.

PARAMETERS:

FAILURE-PROBABILITY	Display the result of a crack growth analysis of the failure probability.
LIFE-TIME	Display the result of a crack growth analysis of the time to failure.

NOTES:

None.

DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY

...	FAILURE-PROBABILITY	fatigpnt/inspect	PROBABILITY
			RELIABILITY-INDEX

PURPOSE:

Display the result of a crack growth analysis of the failure probability.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection for which the analysis was made.
PROBABILITY	Display the probability as a function of time.
RELIABILITY-INDEX	Display the reliability index as a function of time.

NOTES:

1 The SN reliability result may be shown in the same graph. See DEFINE PRESENTATION CRACK-GROWTH-ANALYSIS.

2 The target reliability is shown if it has been assigned.

3 Examples of the display can be seen in Figure 2.6, Figure 2.7, Figure 3.14, Figure 3.17 and Figure 3.19.

See also.

- RUN CRACK-GROWTH-ANALYSIS
- PRINT CRACK-GROWTH-ANALYSIS
- DEFINE PRESENTATION CRACK-GROWTH-ANALYSIS
- SELECT RESULT
- DISPLAY RESULT PARAMETER-STUDY
- SET GRAPH

EXAMPLE:

```
DISPLAY CRACK-GROWTH-ANALYSIS FAILURE C3501 RELIABILITY-INDEX
```

DISPLAY CRACK-GROWTH-ANALYSIS LIFE-TIME

...	LIFE-TIME	fatigpnt/inspect	HISTOGRAM
			DISTRIBUTION
			COMPLEMENTARY-DISTRIBUTION

PURPOSE:

Display the result of a crack growth analysis of the time to failure.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection for which the analysis was made.
HISTOGRAM	Display the histogram for the simulated distribution. This option cannot be used if a Mean value based FORM analysis was performed.
DISTRIBUTION	Display the distribution function for the life time.
COMPLEMENTARY-DISTRIBUTION	Display the complementary distribution function for the life time.

NOTES:

1 Only probabilistic analysis results can be displayed.

2 A probabilistic analysis can also be displayed using the commands SELECT RESULT and DISPLAY RESULT DISTRIBUTION.

See also.

- RUN CRACK-GROWTH-ANALYSIS
- PRINT CRACK-GROWTH-ANALYSIS
- SET GRAPH
- SELECT RESULT
- DISPLAY RESULT DISTRIBUTION

EXAMPLE:

```
DISPLAY CRACK-GROWTH-ANALYSIS LIFE C3501 DISTRIBUTION
```

DISPLAY DISTRIBUTION

...	DISTRIBUTION	univar+	DENSITY
			DISTRIBUTION
			COMPLEMENTARY-DISTRIBUTION

PURPOSE:

Display distribution and density functions for existing variables.

PARAMETERS:

univar+	A selection of one-dimensional distribution variables with numerical or fixed parameters.
DENSITY	Display the density function for the selected variable(s).
DISTRIBUTION	Display the distribution function for the selected variable(s).
COMPLEMENTARY-DISTRIBUTION	Display the complementary distribution function for the selected variable(s).

NOTES:

The functions are calculated within a range of three standard deviations (five standard deviations if limited by a bound) on each side of the mean.

See also.

- DISPLAY RESULT DISTRIBUTION
- DISPLAY FITTED-DISTRIBUTION
- PRINT DISTRIBUTION
- PRINT VARIABLE
- SET GRAPH

EXAMPLE:

```
DISPLAY DISTRIBUTION ( ONLY Width Height ) DENSITY
```

DISPLAY EVENT

<table>
<tr><td rowspan="2">...</td><td rowspan="2">EVENT</td><td rowspan="2">event</td><td>SINGLE</td></tr>
<tr><td>MULTIPLE</td></tr>
</table>

PURPOSE:

Display the definition of an event as a network.

PARAMETERS:

event	The name of the event to be displayed.
SINGLE	Display only the first level subevents.
MULTIPLE	Display the first two levels of subevents as network.

NOTES:

Unions are displayed horizontally and intersections vertically.

See also.

- PRINT EVENT
- SET

EXAMPLE:

```
DISPLAY EVENT Beam-Fail MULTIPLE
```

DISPLAY FITTED-DISTRIBUTION

...	FITTED-DISTRIBUTION	variable

PURPOSE:

Display a fitted distribution with the points it is fitted to.

PARAMETERS:

variable The name of a variable that is assigned a fitted distribution.

NOTES:

1 A spline fit or cumulative fit is displayed as a distribution function curve.

2 A fit to observations is displayed as a histogram with the density function of the fitted distribution. This display can be regulated by use of the SET GRAPH HISTOGRAM command.

See also.

- DISPLAY DISTRIBUTION
- PRINT DISTRIBUTION
- PRINT VARIABLE
- SET

EXAMPLE:

```
DISPLAY FITTED-DISTRIBUTION Spl33
```

DISPLAY FUNCTION

...	FUNCTION	name	[coord]	from	...

<table>
<tr><td rowspan="3">...</td><td>ONE-ARGUMENT</td><td colspan="3">argx, tox</td></tr>
<tr><td rowspan="2">TWO-ARGUMENTS</td><td rowspan="2">argx, tox, argy, toy</td><td colspan="2">SURFACE</td></tr>
<tr><td>CONTOUR</td><td>min, max, step</td></tr>
</table>

PURPOSE:

Display distribution and density functions for existing variables.

PARAMETERS:

name	Name of the function.
[coord]	Coordinate of the function, if multidimensional.
from	Argument value(s) where the calculation of the function is started.
ONE-ARGUMENT	Display the function as a graph with one argument along the abscissa and the function value as the ordinate.
argx	Name of the argument to be used as abscissa.
tox	End value along the abscissa axis.
TWO-ARGUMENT	Display the function as a surface or contour plot. This option is not available for functions with only one argument.
argy	Name of the argument to be used as ordinate.
toy	End value along the ordinate axis.
SURFACE	Show a surface plot.
CONTOUR	Show a contour plot.
min max step	Contour specification: min, min+step, ... until max is reached.

NOTES:

1 Functions where the number of coordinates is defined by the user cannot be displayed.

2 The function option values in effect at the time of display will be used. Note that these may affect the number of arguments of the function, as well as the dimension and function value.

See also.

- DEFINE PRESENTATION FUNCTION
- PRINT FUNCTION
- ASSIGN FUNCTION-OPTION
- SET GRAPH

EXAMPLE:

```
DISPLAY FUNCTION Power 0.0 2.34 ONE-ARG Value 7.0
DISPLAY FUNCTION Power 0.0 1.0 TWO-ARG Value 5.0 Exponent 3.0 SURFACE
```

DISPLAY GEOMETRY-FUNCTION

...	GEOMETRY-FUNCTION	fatigpnt/inspect

PURPOSE:

Display a weld effect assigned to a fatigue point or to an inspection with a repair assigned.

PARAMETERS:

fatigpnt/inspect The name of a fatigue point or an inspection with a geometry function assigned.

NOTES:

1 Geometry functions for two-dimensional crack growth models cannot be displayed.

2 An assigned weld effect is not multiplied on the geometry function as displayed here.

See also.

- ASSIGN GEOMETRY-FUNCTION
- DISPLAY WELD-EFFECT
- SET GRAPH

EXAMPLE:

```
DISPLAY GEOMETRY-FUNCTION C3501
```

DISPLAY JOINT

...	JOINT	ALL
		joint
		set

PURPOSE:

Display one or more joints.

PARAMETERS:

ALL	Display all joints.
joint	Display the one named joint.
set	Display all joints in the named set of joints.

NOTES:

1 This commands requires access to a database produced by Framework.

2 Only those sets of joints that have been created by use of Framework can be selected for display here.

3 The VIEW command may be used to manipulate the display.

4 An example of this display can be found in Figure 3.3.

See also.

- DISPLAY MEMBER
- DISPLAY LABEL
- DISPLAY PRESENTATION
- VIEW

EXAMPLE:

```
DISPLAY JOINT ALL
```

DISPLAY LABEL

...	LABEL	MEMBER-NAMES	...	ON
		JOINT-NAMES		
		CHORD-AND-BRACE		OFF
		FATIGUE-POINT		

PURPOSE:

Turns display of labels on members or joints on or off.

PARAMETERS:

MEMBER-NAMES	Label the member names.
JOINT-NAMES	Label the joint names.
CHORD-AND-BRACE	Label the chord and brace status of each end of members (joint display only).
FATIGUE-POINT	Display the fatigue points positioned on the structure as diamonds.
ON	Turn label ON.
OFF	Turn label OFF.

NOTES:

1 In CHORD-AND-BRACE display:

C =	chord
B =	brace
L =	local chord or both chord and brace
N =	non-pipe
P =	probably a pile
S =	support or free end
E =	element end, when member has been modelled by more than one element

2 An example of this display can be found in Figure 3.3.

See also.

- DISPLAY MEMBER

- DISPLAY JOINT
- DISPLAY PRESENTATION
- VIEW

EXAMPLES:

```
DISPLAY LABEL MEMBER-NAMES ON
```

The default labelling is OFF in all cases.

DISPLAY MEMBER

...	MEMBER	ALL
		member
		set

PURPOSE:

Display one or more members.

PARAMETERS:

ALL	Display all members.
member	Display the one named member.
set	Display all members in the named set of members.

NOTES:

1 This commands requires access to a database produced by Framework.

2 Only those sets of members that have been created by use of Framework can be selected for display here.

3 The command: DISPLAY PRESENTATION may be used to switch between wire-frame display and hidden surface display.

4 The VIEW command may be used to manipulate the display.

5 An example of this display can be found in Figure 3.3.

See also.

- DISPLAY JOINT
- DISPLAY LABEL
- DISPLAY PRESENTATION
- VIEW

EXAMPLE:

```
DISPLAY MEMBER ALL
```

DISPLAY PRESENTATION

<table>
<tr><td rowspan="2">...</td><td rowspan="2">PRESENTATION</td><td colspan="2">WIREFRAME</td></tr>
<tr><td>HIDDEN-SURFACE</td><td>resolution</td></tr>
</table>

PURPOSE:

Switch between wire-frame and hidden surface display.

PARAMETERS:

WIREFRAME	Line display.
HIDDEN-SURFACE	Hidden surface display.
resolution	Numerical factor defining resolution for the hidden-surface display (default value is 1.0, a value of 0.1 will give a coarse resolution).

NOTES:

1 The HIDDEN-SURFACE display is only available in the DISPLAY MEMBER command.

2 The HIDDEN-SURFACE display requires a high performance (gray-scale or colour) workstation or terminal running the X windows system.

See also.

- DISPLAY MEMBER
- VIEW

EXAMPLES:

```
DISPLAY PRESENTATION HIDDEN-SURFACE 0.1
```

DISPLAY RESULT

...	RESULT	DISTRIBUTION	...
		IMPORTANCE-FACTORS	
		PARAMETER-STUDY	

PURPOSE:

Display results generated by PROBAN graphically.

PARAMETERS:

DISTRIBUTION	Display the result of a distribution analysis.
IMPORTANCE-FACTORS	Display the importance factors resulting from a probability analysis.
PARAMETER-STUDY	Display results as a function of the parameter in a parameter study.

NOTES:

None.

DISPLAY RESULT DISTRIBUTION

...	DISTRIBUTION	[value]	univar/result+	DENSITY
				DISTRIBUTION
				COMPLEMENTARY-DISTRIBUTION

PURPOSE:

Display distribution and density functions for existing variables and for results.

PARAMETERS:

[value]	This input is only required if the selected result is a parameter study. value is then one of the parameter values for which the study was run. The particular result from the analysis using the selected value will be displayed.
univar/result+	A selection of one-dimensional distribution variables with numerical or fixed parameters, or of results. The following results may be available: Empirical: The empirical distribution from a simulation. Mean-V-FORM: The distribution calculated in a Mean value based FORM analysis.
DENSITY	Display the density function for the selected variable(s). For an empirical distribution, a histogram is drawn (see also SET GRAPH HISTOGRAM). It is not possible to display the density for a Mean-V-FORM result.
DISTRIBUTION	Display the distribution function for the selected variable(s).
COMPLEMENTARY-DISTRIBUTION	Display the complementary distribution function for the selected variable(s).

NOTES:

1 The distribution and density functions are calculated within a range of three standard deviations on each side of the mean.

2 When a distribution simulation is selected, and no parameter study was performed, two variables are fitted to the estimated moments: a Hermite transformation distribution (using four moments) and a Normal distribution (using two moments). These are available in the variables named Hermite-Fit and Normal-Fit.

3 A histogram cannot be displayed with a logarithmic X or Y axis.

4 The empirical distribution function is calculated as: $F(x_{(i)}) = i/(n+1)$ when n simulations were completed and the sample points have been ordered as: $x_{(1)} \le x_{(2)} \le ... \le x_{(n)}$.

See also.

- DISPLAY DISTRIBUTION
- PRINT RESULT
- SELECT RESULT
- SET

EXAMPLE:

```
DISPLAY RESULT DISTRIBUTION ( ONLY Empirical Normal-Fit ) DENSITY
DISPLAY RESULT DISTRIBUTION ONLY Mean-V-FORM DISTRIBUTION
```

DISPLAY RESULT IMPORTANCE-FACTORS

...	IMPORTANCE-FACTORS	[value+]

PURPOSE:

Display importance factors.

PARAMETERS:

value+ This input is only required if the selected result is a parameter study. value is then a selection of the parameter values for which the study was run. The particular results from the analysis using the selected value(s) will be displayed.

NOTES:

1 The importance factors are displayed as a pie chart.

2 All importance factor values less than a user definable limit are grouped into one segment labelled "Other" (see DEFINE PRESENTATION RESULT IMPORTANCE-LIMIT).

3 The form of the pie charts may be manipulated by use of the command SET GRAPH PIE-CHART.

4 Examples of the display can be seen in Figure 3.11 and Figure 3.16.

See also.

- DEFINE PRESENTATION RESULT IMPORTANCE-LIMIT
- DISPLAY RESULT PARAMETER-STUDY IMPORTANCE-FACTOR
- PRINT RESULT
- SELECT RESULT
- SET

EXAMPLE:

```
DISPLAY RESULT IMPORTANCE-FACTORS              % no parameter study
DISPLAY RESULT IMPORTANCE-FACTORS ONLY 22.5    % pick one from a study
DISPLAY RESULT IMPORTANCE-FACTORS ONLY *       % all results from a study
```

DISPLAY RESULT PARAMETER-STUDY

...	PARAMETER-STUDY	IMPORTANCE-FACTOR	...
		MAIN-RESULT	

PURPOSE:

Display results as a function of the parameter in a parameter study.

PARAMETERS:

IMPORTANCE-FACTOR	Display importance factors as a function of the parameter.
MAIN-RESULT	Display one or more main results as a function of the parameter.

NOTES:

None.

DISPLAY RESULT PARAMETER-STUDY IMPORTANCE-FACTOR

...	IMPORTANCE-FACTOR	impname+

PURPOSE:

Display importance factors as a function of the parameter in a parameter study.

PARAMETERS:

impname+	A selection of importance factor names. The segment named “Other” in the pie chart representation is not used here. All available importance factor names can be selected.

NOTES:

Examples of the display can be seen in Figure 3.11 and Figure 3.16.

See also.

- PRINT RESULT PARAMETER-STUDY IMPORTANCE-FACTOR
- DISPLAY RESULT IMPORTANCE-FACTORS
- SELECT RESULT
- SET

EXAMPLE:

```
DISPLAY RESULT PARAMETER-STUDY IMPORTANCE-FACTOR ( ONLY Depth ImpGroup-1 )
DISPLAY RESULT PARAMETER-STUDY IMPORTANCE-FACTOR ONLY T*
```

DISPLAY RESULT PARAMETER-STUDY MAIN-RESULT

...	MAIN-RESULT	mainres+

PURPOSE:

Display main results as a function of the parameter in a parameter study.

PARAMETERS:

mainres+	A selection of main results. The list of available results depend on the analysis performed. All possible main results are presented in the list, even though they may not all be calculated for all the individual analyses in the parameter study. For deterministic analysis of a variable there will be one result for each coordinate, and for an event there will be one result. These results will be named after the variable or event analysed.

NOTES:

1 All possible main results from probability and distribution analyses are listed in SESAM User's Manual: Proban.

See also:

- PRINT RESULT PARAMETER-STUDY MAIN-RESULT
- SELECT RESULT
- SET

EXAMPLE:

```
DISPLAY RESULT PARAMETER-STUDY MAIN-RESULT ( ONLY Prob* Conf* )
DISPLAY RESULT PARAMETER-STUDY MAIN-RESULT ONLY *Mean*
```

DISPLAY SN-ANALYSIS

...	SN-ANALYSIS	FAILURE-PROBABILITY	...
		LIFE-TIME	

PURPOSE:

Display the result of an SN analysis.

PARAMETERS:

FAILURE-PROBABILITY	Display the result of an SN analysis of the failure probability.
LIFE-TIME	Display the result of an SN analysis of the time to failure.

NOTES:

None.

DISPLAY SN-ANALYSIS FAILURE-PROBABILITY

...	FAILURE-PROBABILITY	fatigpnt/inspect	PROBABILITY
			RELIABILITY-INDEX

PURPOSE:

Display the result of an SN analysis of the failure probability.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection for which the analysis was made.
PROBABILITY	Display the probability as a function of time.
RELIABILITY-INDEX	Display the reliability index as a function of time.

NOTES:

See also:

- RUN SN-ANALYSIS
- PRINT SN-ANALYSIS
- SELECT RESULT
- DISPLAY RESULT PARAMETER-STUDY
- SET GRAPH

EXAMPLE:

```
DISPLAY SN-ANALYSIS FAILURE C3501 RELIABILITY-INDEX
```

DISPLAY SN-ANALYSIS LIFE-TIME

...	LIFE-TIME	fatigpnt/inspect	HISTOGRAM
			DISTRIBUTION
			COMPLEMENTATY-DISTRIBUTION

PURPOSE:

Display the result of an SN analysis of the time to failure.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection for which the analysis was made.
HISTOGRAM	Display the histogram for the simulated distribution. This option cannot be used if a Mean value based FORM analysis was performed.
DISTRIBUTION	Display the distribution function for the life time.
COMPLEMENTARY-DISTRIBUTION	Display the complementary distribution function for the life time.

NOTES:

1 Only probabilistic analysis results can be displayed.

2 A probabilistic analysis can also be displayed using the commands SELECT RESULT and DISPLAY RESULT DISTRIBUTION.

See also:

- RUN SN-ANALYSIS
- PRINT SN-ANALYSIS
- SET GRAPH
- SELECT RESULT
- DISPLAY RESULT DISTRIBUTION

EXAMPLE:

```
DISPLAY SN-ANALYSIS LIFE C3501 DISTRIBUTION
```

DISPLAY SN-CURVE

...	SN-CURVE	name+

PURPOSE:

Display one or more SN curves

PARAMETERS:

name+ Name(s) of SN-curve(s) to be displayed.

NOTES:

1 The SN-curves will always be shown in a log-log scale.

2 If one curve of type STOCHASTIC is displayed, two curves are drawn, using the value of logk with and without the safety factor applied.

3 Examples of the SN curve display can be seen in Figure 3.9.

See also:

- CREATE SN-CURVE
- CHANGE SN-CURVE
- PRINT SN-CURVE
- SET GRAPH

EXAMPLES:

```
DISPLAY SN-CURVE DNV*
```

DISPLAY STRESS-RANGE

...	STRESS-RANGE	fatigpnt/inspect

PURPOSE:

Display the distribution of the stress range assigned to a fatigue point or an inspection.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection with a stress range assignment.

NOTES:

1. A CONSTANT stress range cannot be displayed.
2. A WEIBULL-AB stress range is displayed as an exceedance probability curve for the specified Weibull distribution.
3. A SUM-RAYLEIGH stress range is displayed as the exceedance probability curve for the Sum-Rayleigh distribution.
4. A WEIBULL-FIT stress range is displayed as two exceedance probability curves - for the fitted Weibull distribution and the Sum-Rayleigh distribution - with the fit points imposed.
5. The tail of the stress range distribution may be examined in more detail by setting a logarithmic Y axis: SET GRAPH Y-AXIS SPACING LOGARITHMIC.
6. Examples of the stress range display can be seen in Figure 3.8.

See also:

- ASSIGN STRESS-RANGE
- SET GRAPH

EXAMPLE:

```
DISPLAY STRESS-RANGE C3501
```

DISPLAY SUPERELEMENT

...	SUPERELEMENT

PURPOSE:

Display the finite element model for the current superelement.

PARAMETERS:

None:

NOTES:

This commands requires access to a database produced by Framework or a SIN file.

See also:

- PRINT SUPERELEMENT
- VIEW

EXAMPLE:

```
DISPLAY SUPERELEMENT
```

DISPLAY TRANSFER-FUNCTION

...	TRANSFER-FUNCTION	name+	dir+

PURPOSE:

Display one or more transfer functions at one or more directions.

PARAMETERS:

name+	Name(s) of transfer function(s) to be displayed.
dir+	Selection of directions for which the function(s) is displayed.

NOTES:

1 Invalid combinations of names and directions are ignored.

2 The command DEFINE PRESENTATION TRANSFER-FUNCTION may be used to select the value(s) to be displayed along the ordinate axis.

3 If the ORDINATE-VALUES is set to PHASE-AMPLITUDE or REAL-IMAGINARY, only the first valid combination of name and direction will be displayed.

4 An example of this display can be found in Figure 3.7.

See also:

- CREATE TRANSFER-FUNCTION
- CHANGE TRANSFER-FUNCTION
- PRINT TRANSFER-FUNCTION
- SET GRAPH
- DEFINE PRESENTATION TRANSFER-FUNCTION

EXAMPLES:

```
DISPLAY TRANSFER-FUNCTION TRF* ( 0 45 )
```

DISPLAY WAVE-SPREADING-FUNCTION

...	WAVE-SPREADING-FUNCTION	name	[space]

PURPOSE:

Display one wave spreading function.

PARAMETERS:

name	Name of a wave spreading function.
space	Space between each wave direction angle for which the function is displayed. This value is independent of what the program will use in calculations. This value is only required when a cosine power function is displayed.

NOTES:

See also:

- CREATE WAVE-SPREADING-FUNCTION
- CHANGE WAVE-SPREADING-FUNCTION
- PRINT WAVE-SPREADING-FUNCTION

EXAMPLES:

```
DISPLAY WAVE-SPREADING-FUNCTION COS2 30
DISPLAY WAVE-SPREADING-FUNCTION USERDEF
```

DISPLAY WELD-EFFECT

...	WELD-EFFECT	fatigpnt/inspect

PURPOSE:

Display a weld effect assigned to a fatigue point or to an inspection with a repair assigned.

PARAMETERS:

fatigpnt/inspect The name of a fatigue point or an inspection with a weld effect assigned.

NOTES:

See also:

- ASSIGN WELD-EFFECT
- DISPLAY GEOMETRY-FUNCTION
- SET

EXAMPLE:

```
DISPLAY WELD-EFFECT C3501
```

EXIT

EXIT

PURPOSE:

Close all open files and stop execution of Profast.

PARAMETERS:

None.

NOTES:

1 This command is not available from the menu bar in graphics mode. Use FILE EXIT instead.

2 This command is not journalled.

3 EXIT cannot be abbreviated.

See also:

- FILE EXIT

EXAMPLES:

```
EXIT
```

FILE

FILE	EXIT	...
	OPEN	...

PURPOSE:

To manage file access and close the program.

PARAMETERS:

EXIT	Close all open files and exit the program.
OPEN	Open a SESAM interface file.

NOTES:

None.

FILE EXIT

...	EXIT

PURPOSE:

Close all open files and stop execution of Profast.

PARAMETERS:

None.

NOTES:

1 This command is not journalled.

2 EXIT cannot be abbreviated.

See also:

- FILE EXIT

EXAMPLES:

```
EXIT
```

FILE OPEN

...	OPEN	format	prefix	name

PURPOSE:

To open a Results Interface File.

PARAMETERS:

format	Results Interface File format. One of: SIF-FORMATTED, SIU-UNFORMATTED and SIN-DIRECT-ACCESS.
prefix	Results Interface File prefix.
prefix	Results Interface File name.

NOTES:

This command is only available if no Framework database is used. Its sole purpose is to enable reading of transfer functions from the file.

See also:

- CREATE TRANSFER-FUNCTION

EXAMPLES:

```
FILE OPEN SIN X108A R1
```

HELP

<table>
<tr><td rowspan="12">HELP</td><td colspan="2">ABOUT-HELP</td></tr>
<tr><td colspan="2">COMMAND-INPUT-FILE</td></tr>
<tr><td rowspan="4">LINE-MODE</td><td>COMMANDS</td></tr>
<tr><td>DEFAULTS</td></tr>
<tr><td>SELECTING</td></tr>
<tr><td>OTHER-FACILITIES</td></tr>
<tr><td rowspan="4">PROGRAMMING-MODE</td><td>BUILT-IN</td></tr>
<tr><td>EXPRESSIONS</td></tr>
<tr><td>OVERVIEW</td></tr>
<tr><td>VARIABLES</td></tr>
<tr><td colspan="2">STATUS-LIST</td></tr>
<tr><td colspan="2">SUPPORT</td></tr>
</table>

PURPOSE:

Provide guidance to the user.

PARAMETERS:

ABOUT-HELP	Provide information about the HELP command.
COMMAND-INPUT-FILE	Provide information about command input files.
LINE-MODE	Provide information specific for usage in line mode.
COMMANDS	Provide information about specifying commands in line mode.
DEFAULTS	Provide information about usage of defaults in line mode.
SELECTING	Provide information about selection and abbreviation in line mode.
OTHER-FACILITIES	Provide information about special facilities in line mode.
PROGRAMMING-MODE	Provide information about the programming mode.
BUILT-IN	Provide information about built in functions, procedures and constants, accessible in programming mode.
EXPRESSIONS	Provide information about the use of calculation expressions in programming mode.

OVERVIEW	Provide an overview of the facilities available in programming mode.
VARIABLES	Provide information about the usage of variables in programming mode.
STATUS-LIST	Examine the status list for Profast.
SUPPORT	Provide information that is helpful at a support request. This include information about the versions of the program and linked-in libraries, and about the environment in which the program runs.

NOTES:

1 This command is not journalled.

2 There is no guarantee that this command will remain compatible over time.

3 All information, except the status list, is treated as a program message, i.e. it is written into the message window in graphics mode and echoed at the terminal in line mode. The status list is presented in the print window when running in graphics mode, and presented one screenful at a time when running in line mode.

4 See also the sections in chapter 4 on getting help when running in line mode and in graphics mode.

PLOT

PLOT

PURPOSE:

Execute the last DISPLAY command and write the result to the currently selected plot file.

PARAMETERS:

None.

NOTES:

1 The plot file and format is specified by use of the SET PLOT command.

2 Note that the command does not actually write the display as seen on the screen to file - it re-executes the DISPLAY command, taking any changed settings into account.

3 This command is not available from the menu bar in graphics mode. Use FILE PLOT instead, or use the graphics pick mode.

See also:

- DISPLAY
- FILE PLOT
- SET PLOT

EXAMPLES:

```
PLOT
```

PRINT

PRINT	ANALYSIS-SETTINGS	...
	CALIBRATION-CRACK-GROWTH	...
	CORRELATION	...
	CRACK-GROWTH-ANALYSIS	...
	DISTRIBUTION	...
	EVENT	...
	FATIGUE-POINT	...
	FUNCTION	...
	INSPECTION	...
	PARAMETER-STUDY	...
	PLAN-INSPECTION	...
	RESULT	...
	SN-ANALYSIS	...
	SN-CURVE	...
	STARTING-POIN	...
	TRANSFER-FUNCTION	...
	UNCERTAINTY	...
	VARIABLE	...
	WAVE-SPREADING-FUNCTION	...
	WAVE-STASTISTICS	...

PURPOSE:

To present input data and results graphically.

PARAMETERS:

ANALYSIS-SETTINGS	Print all analysis settings related to probability and distribution analysis.
CALIBRATION-CRACK-GROWTH	Print the result of a crack growth model calibration.
CORRELAPTION	Print all correlations assigned to a selection of variables.
CRACK-GROWTH-ANALYSIS	Print the result of a crack growth analysis.

DISTRIBUTION	Print the distribution and density function of a variable.
EVENT	Print information about a selection of events.
FATIGUE-POINT	Print a fatigue point with all its assignments.
FUNCTION	Print information about a function or a function value/derivative.
INSPECTION	Print an inspection with all its assignments.
PARAMETER-STUDY	Print the assigned parameter study.
PLAN-INSPECTION	Print an inspection plan.
RESULT	Print an analysis result.
SN-ANALYSIS	Print the result of an SN analysis.
SN-CURVE	Print data related to a selection of SN curves.
STARTING-POINT	Print the starting point assignment for a selection of events.
TRANSFER-FUNCTION	Print data for one transfer function.
UNCERTAINTY	Print assigned uncertainty and uncertainty definitions.
VARIABLE	Print information about a selection of variables.
WAVE-SPREADING-FUNCTION	Print information about a wave spreading function.
WAVE-STATISTICS	Print information about a selection of wave statistics.

PRINT ANALYSIS-SETTINGS

...	ANALYSIS-SETTINGS

PURPOSE

Print all analysis options.

PARAMETERS:

None.

NOTES:

1 All analysis options related to probability and distribution analysis are printed, including those for analysis methods that are currently not selected.

See also:

- DEFINE
- SELECT ANALYSIS-METHOD

EXAMPLES:

```
PRINT ANALYSIS-SETTINGS
```

PRINT CALIBRATION-CRACK-GROWTH

...	CALIBRATION-CRACK-GROWTH	fatigue/inspect

PURPOSE:

Print the result of a calibration crack growth model to the SN reliability result.

PARAMETERS:

fatigue/inspect The name of a fatigue point or an inspection for which the calibration was made.

NOTES:

See also:

- RUN CALIBRATION-CRACK-GROWTH
- DISPLAY CALIBRATION-CRACK-GROWTH

EXAMPLE:

```
RUN CALIBRATION-CRACK-GROWTH
```

may generate the following print:

```
Crack growth calibration for Fatigue point: J3220
Parameter 1 : J3220-GFacto-Mean
It Parameter 1 2000.50 2010.50 2030.50  Step  Dist
---------------------------------------------------
SN   Not used    3.576   2.867   2.172 0.0010  0.30
 0  1.0000E+00   1.173   0.574   0.005 2.2896  2.29
 1  2.2360E-01   6.301   5.584   4.876 5.0043  2.72
 2  3.9236E-01   4.289   3.601   2.925 1.9821  0.73
 3  4.7592E-01   3.618   2.942   2.282 0.6580  0.08
 4  4.8653E-01   3.542   2.868   2.209 0.0742  0.03
 5  4.8666E-01   3.541   2.867   2.208 0.0009  0.03
```

PRINT CORRELATION

...	CORRELATION	univar+

PURPOSE:

Print assigned correlations.

PARAMETERS:

univar+ A selection of variables that are defined as one dimensional distributions with numerical or fixed parameters. All correlations assigned to pairs of these variables are printed. If only one variable is selected, all correlations assigned to this variable will be printed.

NOTES:

See also:

- ASSIGN CORRELATION
- SET TITLE

EXAMPLES:

```
PRINT CORRELATION *
```

May generate the following print:

```
                      +---------------------------------+
                      ! Correlations between variables !
                      +---------------------------------+

Variable 1   Variable 2   Input      Basic         Normalized
-----------------------------------------------------------------------------
J3220-lnA    J5120-lnA    Basic      CorrStress
```

PRINT CRACK-GROWTH-ANALYSIS

...	CRACK-GROWTH-ANALYSIS	FAILURE-PROBABILITY	fatigpnt/inspect
		LIFE-TIME	fatigpnt/inspect

PURPOSE:

Print the results of a crack growth analysis.

PARAMETERS:

FAILURE-PROBABILITY	Print the result of a crack growth analysis of the failure probability.
LIFE-TIME	Print the result of a crack growth analysis of the time to failure.
fatigpnt/inspect	The fatigue point or inspection for which the analysis was made.

NOTES:

See also:

- DEFINE CRACK-GROWTH-ANALYSIS
- RUN CRACK-GROWTH-ANALYSIS
- DISPLAY CRACK-GROWTH-ANALYSIS

EXAMPLE:

```
PRINT CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220
```

may generate the following print:

```
Crack growth analysis result for fatigue point: J3220

 Time      Prob     Beta   Remark
-------------------------------------------------------------------
1990.50                    Start of service life
1990.91 5.7668E-12  6.7859
1992.15 4.4030E-08  5.3498
1994.22 3.0051E-06  4.5260
1997.11 3.9027E-05  3.9503
2000.83 2.2458E-04  3.5094
2000.83                    Inspection: J3220-1 performed
2001.25 3.1049E-06  4.5191
2002.52 2.0753E-05  4.0989
2004.63 8.0091E-05  3.7747
2007.58 2.3986E-04  3.4918 Inspection: J3220-2 performed
```

```
2008.10 2.8980E-06  4.5337
2009.66 1.9760E-05  4.1103
2012.26 7.7768E-05  3.7821
2015.90 2.3563E-04  3.4966
2015.90                    Inspection: J3220-3 performed
2016.19 1.0404E-06  4.7454
2017.05 5.8035E-06  4.3848
2018.49 1.9260E-05  4.1162
2020.50 5.0726E-05  3.8871 End of service life
```

PRINT DISTRIBUTION

...	DISTRIBUTION	univar	LOW-RESOLUTION	
			HIGH-RESOLUTION	n
			FRACTILE	probability*
			PROBABILITY	fractile*

PURPOSE:

Print distribution- and density functions and fractile values for the variables assigned distributions with fixed or numerical parameters.

PARAMETERS:

univar+	A variable that is defined as a one dimensional distributions with numerical or fixed parameters.
LOW-RESOLUTION	Print a table of the distribution, complementary distribution and density function values at 19 fixed probability values ranging from 0.001 to 0.999.
HIGH-RESOLUTION n	Print a table of the distribution, complementary distribution and density function values at n points ranging from median - 4 standard deviations to median + 4 standard deviations.
FRACTILE probability*	Print fractile values at the specified probabilities. Also prints the complementary distribution and density function at the specified points.
PROBABILITY fractile*	Print probabilities (distribution function values) at the specified fractiles. Also prints the complementary distribution and density function at the specified points.

NOTES:

1If a LOOP is specified in line mode input after DISTRIBUTION, any specified fractiles or probabilities are kept as defaults. Otherwise, the default set of fractiles and probabilities is empty.

See also:

- DISPLAY DISTRIBUTION
- PRINT VARIABLE
- SET TITLE

EXAMPLES:

```
PRINT DISTRIBUTION StdNormal LOW-RESOLUTION
```

May generate the following print:

```
                         +----------------------------+
                         ! Distribution of StdNormal !
                         +----------------------------+

           Variable     Type         Parameter         Value
           -------------------------------------------------------
           StdNormal    Normal       Mean              0.000000000E+00
                                     Stand-Dev         1.000000000E+00

                 Fractile      Distr     Compl       Density
             ---------------------------------------------------
             -3.090232306E+00 0.001000 0.999000  3.367090077E-03
             -2.326347874E+00 0.010000 0.990000  2.665214220E-02
             -1.644853627E+00 0.050000 0.950000  1.031356404E-01
             -1.281551566E+00 0.100000 0.900000  1.754983319E-01
             -1.036433389E+00 0.150000 0.850000  2.331587753E-01
             -8.416212336E-01 0.200000 0.800000  2.799619204E-01
             -6.744897502E-01 0.250000 0.750000  3.177765727E-01
             -5.244005127E-01 0.300000 0.700000  3.476926142E-01
             -2.533471031E-01 0.400000 0.600000  3.863425335E-01
              5.293868432E-14 0.500000 0.500000  3.989422804E-01
              2.533471031E-01 0.600000 0.400000  3.863425335E-01
              5.244005127E-01 0.700000 0.300000  3.476926142E-01
              6.744897502E-01 0.750000 0.250000  3.177765727E-01
              8.416212336E-01 0.800000 0.200000  2.799619204E-01
              1.036433389E+00 0.850000 0.150000  2.331587753E-01
              1.281551566E+00 0.900000 0.100000  1.754983319E-01
              1.644853627E+00 0.950000 0.050000  1.031356404E-01
              2.326347874E+00 0.990000 0.010000  2.665214220E-02
```

PRINT EVENT

...	EVENT	name+

PURPOSE:

Print information about one or more events.

PARAMETERS:

name+ Name(s) of event(s) to be printed.

NOTES:

The printout contains information about the event data, including all assignments except starting point.

See also:

- CREATE EVENT
- CHANGE EVENT
- DISPLAY EVENT
- ASSIGN STARTING-POINT
- ASSIGN MEASURED-VALUE
- SET TITLE

EXAMPLES:

```
PRINT EVENT ( J3220-CGFail J5-I1-INAll )
```

May generate the following print:

```
                              +-----------------------------------------------+
                              !                      Event                    !
                              +-----------------------------------------------+
                              !                  J3220-CGFail                 !
                              ! Crack growth failure for fatigue point J3220 !
                              +-----------------------------------------------+

Event-type    Subevent     Subtype      Contents
-------------------------------------------------------------------------------
Single                                  J3220-CGFail  0.0


                                  +-----------------------------+
                                  !            Event            !
                                  +-----------------------------+
```

```
                        !         J5-I1-INAll         !
                        ! All inspections up to J5-I1 !
                        +-----------------------------+

Event-type   Subevent     Subtype      Contents
-------------------------------------------------------------------------------
Intersection J5-I1-INLen  Single       J5-I1-INLen = 0.0
```

PRINT FATIGUE-POINT

...	FATIGUE-POINT	name+

PURPOSE:

Print information about one or more fatigue points.

PARAMETERS:

name+ Name(s) of fatigue point(s) to be printed.

NOTES:

The printout contains information about the fatigue point data, including all assignments.

See also:

- CREATE FATIGUE-POINT
- DELETE FATIGUE-POINT
- PRINT INSPECTION

EXAMPLES:

```
PRINT FATIGUE-POINT J5120
```

May generate the following print:

```
FatigPnt Contents         Value
------------------------------------------------------------------------------
J5120    Type             Hotspot in brace at chord/brace connection
         Position         Joint 5120, Brace 35415, Hotspot 10 in Brace
         Outer Diam       700.0   Uncertainty: None
         Thickness        20.0   Uncertainty: None
         Target Rel.      Not assigned
         Insp. Qual.      Not assigned
         Inspection       None performed
         SCF              SCFax :     2.50000   Uncertainty: None
                          SCFipb:     3.53553   Uncertainty: None
                          SCFopb:     3.53553   Uncertainty: None
                          1/Area:    2.3405139E-05
                          z/Iy  :   -1.0012924E-07
                          y/Iz  :    1.0012924E-07
                          Common factor: 1.0   Uncertainty: None
         Transfer Func    Wave height linearisation
                           axi: J5120TRA  ipb: J5120TRI  opb: J5120TRO
                          Factor a: 1.0   Uncertainty: None
                          Factor b: 0.0   Uncertainty: None
                          Factor c: 0.0   Uncertainty: None
```

```
                 Stress resp. factor: 1.0   Uncertainty: None
Stress range     Sum Rayleigh distribution is calculated
SN Curve         DNVX
                 lK0   : Normal( Mean-StD 15.3801 , 0.4)
                 m0    : 4.1   Uncertainty: None
                 lN0   : 8.301   Uncertainty: None
Miner Sum        1.0   Uncertainty: None
```

PRINT FUNCTION

<table>
<tr><td rowspan="5">...</td><td rowspan="5">FUNCTION</td><td>DESCRIPTION</td><td>...</td></tr>
<tr><td>FORMULA</td><td>...</td></tr>
<tr><td>GRADIENT</td><td>...</td></tr>
<tr><td>LIBRARY</td><td>...</td></tr>
<tr><td>VALUE</td><td>...</td></tr>
</table>

PURPOSE:

Print information about the model functions that are available in the program.

PARAMETERS:

DESCRIPTION	Print a description of one or more functions.
FORMULA	Print a function formula.
GRADIENT	Calculate and print a gradient for a function.
LIBRARY	Print a description of a selection of function libraries.
VALUE	Calculate and print a gradient for a function.

NOTES:

None.

PRINT FUNCTION DESCRIPTION

...	DESCRIPTION	name+

PURPOSE:

Print a description of a selection of functions.

PARAMETERS:

name+ Name(s) of the function(s) to be printed.

NOTES:

The selection of functions presented is determined by the current selection of sub-libraries (see SELECT FUNCTION-LIBRARY). This is because some libraries may contain a large number of functions and/or not be relevant to the current problem.

See also:

- SELECT FUNCTION-LIBRARY
- PRINT FUNCTION-LIBRARY
- SET TITLE

EXAMPLES:

```
PRINT FUNCTION DESCRIPTION Difference
```

Generates the following print:

```
                            +---------------------+
                            !      Function       !
                            +---------------------+
                            !     Difference      !
                            ! Difference X1 - X2 !
                            +---------------------+

                   The function belongs to sublibrary: Misc

              First and second order derivatives are implemented


             Name         Description
----------------------------------------------------------------------------
Arguments:   Additive-Arg Additive argument
             Subtract-Arg Subtractive argument
```

PRINT FUNCTION FORMULA

...	FORMULA	name+

PURPOSE:

Print a description of a selection of function formulas.

PARAMETERS:

name+ Name(s) of the function formula(s) to be printed.

NOTES:

Prints the name, description, argument list, calculation scheme and definition of a function formula.

See also:

- CREATE FUNCTION FORMULA
- CHANGE FUNCTION FORMULA
- DELETE FUNCTION FORMULA
- RENAME FUNCTION FORMULA
- SET TITLE

EXAMPLES:

```
PRINT FUNCTION FORMULA SYMFUN
```

Generates the following print:

```
                            +---------------------+
                            !      Function       !
                            +---------------------+
                            !       SYMFUN        !
                            ! Symbolic Function   !
                            +---------------------+

                    Gradients must be calculated numerically

Name          DescriptionValue Index
----------------------------------------------------------------------------
A             Arg AV1
B             Arg BV2

Operator      OperandsResult
----------------------------------------------------------------------------
+             V1 V2V3

Formula: A+B
```

PRINT FUNCTION GRADIENT

...	GRADIENT	function	SINGLE-POINT	ANALYTICAL	[dim]	arguments
				NUMERICAL		
				CHECK		

PURPOSE:

Calculate and print the gradient of a function.

PARAMETERS:

function	Name of the function to be printed.
SINGLE-POINT	The gradient is to be calculated in a single point.
ANALYTICAL	Calculate only analytical gradients (i.e. those that are programmed into the function). This option is not available if the function cannot calculate gradients.
NUMERICAL	Calculate gradients by numerical differentiation only.
CHECK	Calculate both analytical and numerical gradients, and print both.
[dim]	The dimension of the value calculated by the function. Is not required as input if the dimension is fixed.
arguments	The arguments of the function.

NOTES:

1 The selection of functions presented is determined by the current selection of sub-libraries (see SELECT FUNCTION-LIBRARY). This is because some libraries may contain a large number of functions and/or not be relevant to the current problem.

2 If a LOOP is specified in line mode input after function, any specified argument values are kept as defaults. Otherwise, the default set of argument values is empty.

See also:

- SELECT FUNCTION-LIBRARY
- PRINT FUNCTION VALUE
- SET TITLE

EXAMPLES:

```
PRINT FUNCTION GRADIENT Power SINGLE-POINT CHECK 4 3
```

Generates the following print:

```
                          +-------------------------+
                          !        Function         !
                          +-------------------------+
                          !          Power          !
                          ! Power function: X1**X2  !
                          +-------------------------+

             Function      Argument          Value          Numerical
------------------------------------------------------------------------
Argument:                  Value          4.000000000E+00
                           Exponent       3.000000000E+00

Function:    Power                        6.400000000E+01


Gradient:    Power         Value          4.800000000E+01  4.804801600E+01
             Power         Exponent       8.872283911E+01  8.890758910E+01
```

PRINT FUNCTION LIBRARY

...	LIBRARY	name+

PURPOSE:

Print a description of a selection of function libraries.

PARAMETERS:

name+ Name(s) of the function libraries to be printed.

NOTES:

See also:

- SELECT FUNCTION-LIBRARY
- PRINT FUNCTION DESCRIPTION

EXAMPLES:

```
PRINT FUNCTION LIBRARY Misc
```

May generate the following print:

```
                      +----------------------------------+
                      !           Sublibrary             !
                      +----------------------------------+
                      !               Misc               !
                      ! Miscellaneous general functions !
                      +----------------------------------+

Function     Dimen  NArg NOp Description
---------------------------------------------------------------------------------
Difference       1      2   0 Difference X1 - X2
Division         1      2   0 Division X1 / X2
Identity         1      1   0 Identity: f(x) = x
Linear-Comb      1 Input   0 Linear combination: x1*x2 + x3*x4 + ...
Log-Diff         1      2   0 Difference: Log(X1) - Log(X2)
Maximum          1 Input   0 Maximum of any number of variables
Minimum          1 Input   0 Minimum of any number of variables
Polynom-1        1      4   0 Polynomium of degree 1
Polynom-2        1      5   0 Polynomium of degree 2
Polynom-3        1      6   0 Polynomium of degree 3
Polynom-4        1      7   0 Polynomium of degree 4
Polynom-N        1 Input   0 Polynomium(N,X,X0,C0,...): Sum of Ci*((X-X0)**i)
Power-Diff       1      3   0 Difference: X1**X3 - X2**X3
Product          1 Input   0 Product of any number of variables
SignPowDiff      1      3   0 Sign(X1)*(Abs(X1)**X3) - Sign(X2)*(Abs(X2)**X3)
Sum              1 Input   0 Sum of any number of variables
```

PRINT FUNCTION VALUE

...	VALUE	function	SINGLE-POINT	[dim]	arguments

PURPOSE:

Calculate and print the value of a function.

PARAMETERS:

function	Name of the function to be printed.
SINGLE-POINT	The value is to be calculated in a single point.
[dim]	The dimension of the value calculated by the function. Is not required as input if the dimension is fixed.
arguments	The arguments of the function.

NOTES:

1 The selection of functions presented is determined by the current selection of sub-libraries (see SELECT FUNCTION-LIBRARY). This is because some libraries may contain a large number of functions and/or not be relevant to the current problem.

2 If a LOOP is specified in line mode input after function, any specified argument values are kept as defaults. Otherwise, the default set of argument values is empty.

See also:

- SELECT FUNCTION-LIBRARY
- PRINT FUNCTION GRADIENT
- SET TITLE

EXAMPLES:

```
PRINT FUNCTION VALUE Polynomial-2 SINGLE-POINT 11 0 4 2 -6
```

Generates the following print:

```
                                          +------------------------+
                                          !        Function        !
                                          +------------------------+
                                          !       Polynom-2        !
                                          ! Polynomium of degree 2 !
                                          +------------------------+

                    Name         Value
-----------------------------------------------------------------------------
```

```
Arguments:   Argument       1.100000000E+01
             Shift          0.000000000E+00
             Coef-0         4.000000000E+00
             Coef-1         2.000000000E+00
             Coef-2        -6.000000000E+00

Function:    Polynom-2     -7.000000000E+02
```

PRINT INSPECTION

...	INSPECTION	name+

PURPOSE:

Print information about one or more inspections.

PARAMETERS:

name+ Name(s) of inspection(s) to be printed.

NOTES:

The printout contains information about the inspection data, including all assignments.

See also:

- CREATE INSPECTION
- ASSIGN STRESS-RANGE
- ASSIGN SCF FATIGUE-POINT
- ASSIGN INFLUENCE-COEFFICIENTS FATIGUE-POINT
- ASSIGN TRANSFER-FUNCTION FATIGUE-POINT
- ASSIGN CRACK-GROWTH-MODEL
- ASSIGN WELD-EFFECT

EXAMPLES:

```
PRINT INSPECTION J5-I1
```

May generate the following print:

```
 Inspectn Contents         Value
 -------------------------------------------------------------------------------
 J5-I1    Type             Inspection of fatigue point J5120 at time 1994.5
          Description      First inspection at J5120
          Crack Depth      Not observed
          Crack length     Crack size is equal to 5.0 (Unc: Stdv 0.2)
          Repair           Not performed
```

PRINT PARAMETER-STUDY

...	PARAMETER-STUDY

PURPOSE:

Print the currently assigned parameter study.

PARAMETERS:

None.

NOTES:

See also:

- DEFINE PARAMETER-STUDY
- DEFINE ANALYSIS-OPTION PARAMETER-STUDY
- SET TITLE

EXAMPLES:

```
PRINT PARAMETER-STUDY
```

May generate the following print:

```
                         +--------------------------+
                         ! Assigned parameter study !
                         +--------------------------+

              Variable     Parameter    Number      Value
              -------------------------------------------------
              Nyears       Constant         10   2.000000000E+00
                                                 4.000000000E+00
                                                 6.000000000E+00
                                                 8.000000000E+00
                                                 1.000000000E+01
                                                 1.500000000E+01
                                                 2.000000000E+01
                                                 3.000000000E+01
                                                 5.000000000E+01
                                                 1.000000000E+02
```

PRINT PLAN-INSPECTION

...	PLAN-INSPECTION	name	CHRONOLOGICAL
			POINTWISE

PURPOSE:

Print an inspection plan.

PARAMETERS:

name	The name of the plan.
CHRONOLOGICAL	Print the plan with inspections in increasing order of time.
POINTWISE	Print the plan fatigue point by fatigue point.

NOTES:

See also:

- RUN PLAN-INSPECTION
- DELETE PLAN-INSPECTION

EXAMPLE:

```
PRINT PLAN-INSPECTION OPT CHRONOLOGICAL
```

may generate the following print:

```
Inspection plan : OPT
Description     : Optimised plan
Method          : Inspect when target reliability is reached
Start Time      : 1990.50
End Service Life: 2020.50

FatigPnt Target Reliab   Time  POD Curve    Dir Remark
-------------------------------------------------------------------------------
J5120     3.000  2.994 1993.58 PODL-MPI-UW  Len Jnt 5120
J5120     3.000  3.003 1995.70 PODL-MPI-UW  Len Jnt 5120
J5120     3.000  2.991 1998.48 PODL-MPI-UW  Len Jnt 5120
J3220     3.500  3.509 2000.83 PODL-MPI-UW  Len Jnt 3220
J5120     3.000  3.001 2001.85 PODL-MPI-UW  Len Jnt 5120
J5120     3.000  2.993 2005.93 PODL-MPI-UW  Len Jnt 5120
J3220     3.500  3.492 2007.58 PODL-MPI-UW  Len Jnt 3220
J5120     3.000  2.992 2010.66 PODL-MPI-UW  Len Jnt 5120
J3220     3.500  3.497 2015.90 PODL-MPI-UW  Len Jnt 3220
J5120     3.000  2.990 2016.06 PODL-MPI-UW  Len Jnt 5120
```

```
PRINT PLAN-INSPECTION OPT POINTWISE
```

may generate the following print:

```
Inspection plan : OPT
Description     : Optimised plan
Method          : Inspect when target reliability is reached
Start Time      : 1990.50
End Service Life: 2020.50

FatigPnt Target Reliab   Time  POD Curve    Dir Remark
-------------------------------------------------------------------------------

J3220     3.500  3.509 2000.83 PODL-MPI-UW  Len Jnt 3220
                 3.492 2007.58 PODL-MPI-UW  Len
                 3.497 2015.90 PODL-MPI-UW  Len
J5120     3.000  2.994 1993.58 PODL-MPI-UW  Len Jnt 5120
                 3.003 1995.70 PODL-MPI-UW  Len
                 2.991 1998.48 PODL-MPI-UW  Len
                 3.001 2001.85 PODL-MPI-UW  Len
                 2.993 2005.93 PODL-MPI-UW  Len
                 2.992 2010.66 PODL-MPI-UW  Len
                 2.990 2016.06 PODL-MPI-UW  Len
```

PRINT RESULT

<table>
<tr><td rowspan="8">...</td><td rowspan="8">RESULT</td><td>ALL</td><td>...</td></tr>
<tr><td>ANALYSIS-SETTINGS</td><td>...</td></tr>
<tr><td>IMPORTANCE-FACTORS</td><td>...</td></tr>
<tr><td>INTERMEDIATE-RESULTS</td><td>...</td></tr>
<tr><td>PARAMETER-STUDY</td><td>...</td></tr>
<tr><td>SAMPLE</td><td>...</td></tr>
<tr><td>SENSITIVITY</td><td>...</td></tr>
<tr><td>SUMMARY</td><td>...</td></tr>
</table>

PURPOSE:

Print the currently selected result in tabular form, to screen or to file.

PARAMETERS:

ALL	Print all the results from a probability or distribution analysis.
ANALYSIS-SETTINGS	Print analysis options applied to the result.
IMPORTANCE-FACTORS	Print the importance factors resulting from a probability analysis.
INTERMEDIATE-RESULTS	Print the intermediate (debug) results from a probability or distribution analysis.
PARAMETER-STUDY	Print results as a function of the parameter in a parameter study.
SAMPLE	Print the sample resulting from application of a simulation method.
SENSITIVITY	Print parametric sensitivity results.
SUMMARY	Print a summary of the results from a probability or distribution analysis.

NOTES:

None.

PRINT RESULT ALL

...	ALL	[value+]

PURPOSE:

Print all information from the selected result.

PARAMETERS:

value+	This input is only required if the selected result is a parameter study. value is then a selection of the parameter values for which the study was run. The particular results from the analysis using the selected value(s) will be printed.

NOTES:

The print does not contain the sample resulting from a simulation. This sample will often be very large, and it can be printed by use of PRINT RESULT SAMPLE.

See also:

- SELECT RESULT
- SET TITLE

EXAMPLE:

```
PRINT RESULT ALL           % no parameter study
DISPLAY RESULT ALL *       % all results from a study
```

PRINT RESULT ANALYSIS-SETTINGS

...	ANALYSIS-SETTINGS

PURPOSE:

Print analysis options applied to a probability or distribution analysis.

PARAMETERS:

None.

NOTES:

This print contains the date/time and cpu time consumption for the analysis.

See also:

- DEFINE
- RUN PROBABILITY-ANALYSIS
- RUN DISTRIBUTION-ANALYSIS
- SELECT RESULT
- SET TITLE

EXAMPLES:

```
PRINT RESULT ANALYSIS-SETTINGS
```

PRINT RESULT IMPORTANCE-FACTORS

...	IMPORTANCE-FACTORS	[value+]

PURPOSE:

Print importance factors.

PARAMETERS:

value+	This input is only required if the selected result is a parameter study. value is then a selection of the parameter values for which the study was run. The particular results from the analysis using the selected value(s) will be printed.

NOTES:

The smallest importance factor values may be removed from the print (see DEFINE PRESENTATION RESULT IMPORTANCE-CUTOFF).

See also:

- DEFINE PRESENTATION RESULT IMPORTANCE-CUTOFF
- PRINT RESULT PARAMETER-STUDY IMPORTANCE-FACTOR
- PRINT RESULT
- SELECT RESULT
- SET TITLE

EXAMPLE:

```
PRINT RESULT IMPORTANCE-FACTORS           % no parameter study
DISPLAY RESULT IMPORTANCE-FACTORS *       % all results from a study
```

PRINT RESULT INTERMEDIATE-RESULTS

...	INTERMEDIATE-RESULTS

PURPOSE:

Print all intermediate results from the selected analysis result.

PARAMETERS:

None.

NOTES:

1 The intermediate results are generated during the analysis. The amount of intermediate results is controlled by use of the commands DEFINE ANALYSIS-OPTION INTERMEDIATE-RESULTS and DEFINE ANALYSIS-OPTIONS GENERATED-DISTRIBUTION INTERMEDIATE-RESULTS.

2 The print may be very long, depending on the amount of intermediate results requested.

3 The intermediate results form a parameter study cannot be selected separately. They will be printed in the order in which the parameter study was performed.

See also:

- DEFINE ANALYSIS-OPTION INTERMEDIATE-RESULTS
- DEFINE ANALYSIS-OPTION GENERATED-DISTRIBUTION INTERMEDIATE-RESULTS
- SELECT RESULT
- SET TITL

EXAMPLES:

```
PRINT RESULT INTERMEDIATE-RESULTS
```

PRINT RESULT PARAMETER-STUDY

...	PARAMETER-STUDY	IMPORTANCE-FACTOR	...
		MAIN-RESULT	

PURPOSE:

Print results as a function of the parameter in a parameter study.

PARAMETERS:

IMPORTANCE-FACTOR	Print importance factors as a function of the parameter.
MAIN-RESULT	Print one or more main results as a function of the parameter.

NOTES:

None.

PRINT RESULT PARAMETER-STUDY IMPORTANCE-FACTOR

...	IMPORTANCE-FACTOR	impname+

PURPOSE:

Print importance factors as a function of the parameter in a parameter study.

PARAMETERS:

impname+ A selection of importance factor names. The segment named “Other” in the pie chart representation is not used here. All available importance factor names can be selected.

NOTES:

See also:

- DISPLAY RESULT PARAMETER-STUDY IMPORTANCE-FACTOR
- PRINT RESULT IMPORTANCE-FACTORS
- SELECT RESULT
- SET TITLE

EXAMPLE:

```
PRINT RESULT PARAMETER-STUDY IMPORTANCE-FACTOR ( ONLY Depth ImpGroup-1 )
PRINT RESULT PARAMETER-STUDY IMPORTANCE-FACTOR ONLY T*
```

PRINT RESULT PARAMETER-STUDY MAIN-RESULT

...	MAIN-RESULT	mainres+

PURPOSE:

Print main results as a function of the parameter in a parameter study.

PARAMETERS:

mainres+	A selection of main results. The list of available results depend on the analysis performed. All possible main results are presented in the list, even though they may not all be calculated for all the individual analyses in the parameter study. For deterministic analysis of a variable there will be one result for each coordinate, and for an event there will be one result. These results will be named after the variable or event analysed.

NOTES:

1 All possible main results from probability and distribution analyses are listed in SESAM User's Manual: Proban.

See also:

- DISPLAY RESULT PARAMETER-STUDY MAIN-RESULT
- SELECT RESULT
- SET TITLE

EXAMPLE:

```
PRINT RESULT PARAMETER-STUDY MAIN-RESULT ( ONLY Prob* Conf* )
PRINT RESULT PARAMETER-STUDY MAIN-RESULT ONLY *Mean*
```

PRINT RESULT SAMPLE

...	SAMPLE	[value+]

PURPOSE:

Print the simulated sample values.

PARAMETERS:

value+	This input is only required if the selected result is a parameter study. value is then a selection of the parameter values for which the study was run. The particular results from the analysis using the selected value(s) will be printed.

NOTES:

The sample values are printed in the order of sampling as well as in sorted order.

See also:

- DEFINE PROBABILITY-ANALYSIS
- DEFINE DISTRIBUTION-ANALYSIS
- SET TITLE

EXAMPLE:

```
PRINT RESULT SAMPLE
```

may generate the following print (the middle part has been deleted):

```
+------------------------------------------+
!         Fatigue by Wave Loading          !
+------------------------------------------+
! Distribution of: Fatigue                 !
!                  Fatigue Life, SN II     !
! Analysis method: Monte Carlo simulation  !
+------------------------------------------+


          Simulated observations

 SimNo   Observation          Sorted
----------------------------------------
     1  1.250006452E+00  5.434747166E-01
     2  1.654419430E+00  7.556362734E-01
     3  1.720372986E+00  8.169615974E-01
   etc...
   998  1.855419752E+00  3.855307126E+00
   999  1.595765862E+00  3.974120779E+00
```

```
1000  2.576417734E+00  4.111996924E+00
```

PRINT RESULT SENSITIVITY

...	SENSITIVITY	[value+]

PURPOSE:

Print the parametric sensitivity values for the selected result.

PARAMETERS:

value+	This input is only required if the selected result is a parameter study. value is then a selection of the parameter values for which the study was run. The particular results from the analysis using the selected value(s) will be printed.

NOTES:

1 The sensitivity values are printed for the probability itself, the logarithm of the probability and for the reliability index.

2 The sensitivity measure is calculated as the change in the target value resulting from a fixed percentage increase in the parameter. This value is an attempt to provide a dimensionless sensitivity measure. The definition of the sensitivity measure can be changed using the command: DEFINE PRESENTATION RESULT SENSITIVITY-MEASURE.

See also:

- DEFINE PRESENTATION RESULT SENSITIVITY-MEASURE.
- ASSIGN SENSITIVITY
- DEFINE ANALYSIS-OPTION SENSITIVITY
- SELECT RESULT
- SET TITLE

EXAMPLE:

```
PRINT RESULT SENSITIVITY
```

may generate the following print:

```
                    +---------------------------------------+
                    ! Probability of : Fatigue  0.0         !
                    !                  Fatigue Life, SN II  !
                    ! Analysis method: SORM                 !
                    +---------------------------------------+


       Parametric sensitivity result for Probability = 1.67162275386E-08
```

```
Variable      Type          Parameter      Value    dProb/dPar  Measure
-----------------------------------------------------------------------
Scale         Normal        Mean          5.048E+00  7.229E-08  3.65E-08
                            Stand-Dev     6.000E-01  1.815E-07  1.09E-08

          Parametric sensitivity result for Beta = 5.5224397018

Variable      Type          Parameter      Value    dBeta/dPar  Measure
-----------------------------------------------------------------------
Scale         Normal        Mean          5.048E+00 -7.596E-01  -0.38347
                            Stand-Dev     6.000E-01 -1.907E+00  -0.11442

      Parametric sensitivity result for Log10(Prob) = -7.7768617259

Variable      Type          Parameter      Value    dLg10/dPar  Measure
-----------------------------------------------------------------------

Scale         Normal        Mean          5.048E+00  1.878E+00   0.94814
                            Stand-Dev     6.000E-01  4.715E+00   0.28290
```

PRINT RESULT SUMMARY

...	SUMMARY	[value+]

PURPOSE:

Print a short summary for the selected result.

PARAMETERS:

value+ This input is only required if the selected result is a parameter study. value is then a selection of the parameter values for which the study was run. The particular results from the analysis using the selected value(s) will be printed.

NOTES:

See also:

- SELECT RESULT
- SET PRINT

EXAMPLE:

```
PRINT RESULT SUMMARY
```

may generate the following print:

```
  +---------------------------------------+
  !       Fatigue by Wave Loading         !
  +---------------------------------------+
  ! Probability of : Fatigue  0.0         !
  !                  Fatigue Life, SN II  !
  ! Analysis method: SORM                 !
  +---------------------------------------+


FORM Probability:                1.72486E-08
SORM Probability:                1.67162E-08

FORM Reliability index:               5.5169
SORM Reliability index:               5.5224
```

PRINT SN-ANALYSIS

...	SN-ANALYSIS	FAILURE-PROBABILITY	fatigpnt/inspect
		LIFE-TIME	fatigpnt/inspect

PURPOSE:

Print the results of an SN analysis.

PARAMETERS:

FAILURE-PROBABILITY	Print the result of an SN analysis of the failure probability.
LIFE-TIME	Print the result of an SN analysis of the time to failure.
fatigpnt/inspect	The a fatigue point or inspection for which the analysis was made.

NOTES:

See also:

- RUN SN-ANALYSIS
- DISPLAY SN-ANALYSIS

EXAMPLE:

```
PRINT SN-ANALYSIS FAILURE-PROBABILITY J3220
```

may generate the following print:

```
SN analysis result for fatigue point: J3220

 Time      Prob      Beta   Remark
-------------------------------------------------------------------
1990.50                     Start of service life
1990.80 2.3710E-13  7.2325
1991.70 3.7082E-09  5.7812
1993.20 4.0251E-07  4.9341
1995.30 7.2810E-06  4.3352
1998.00 5.3823E-05  3.8727
2001.30 2.3552E-04  3.4967
2005.20 7.3477E-04  3.1806
2009.70 1.8157E-03  2.9085
2014.80 3.7915E-03  2.6701
2020.50 6.9805E-03  2.4583 End of service life
```

PRINT SN-CURVE

...	SN-CURVE	name+

PURPOSE:

Print information about one or more SN curves.

PARAMETERS:

name+ Name(s) of SN-curve(s) to be printed.

NOTES:

See also:

- CREATE SN-CURVE
- CHANGE SN-CURVE
- DISPLAY SN-CURVE
- SET GRAPH

EXAMPLES:

```
PRINT SN-CURVE DNV*
```

may generate the following print:

```
Name     Branch      m         S        LogN    LogA    logK   Std(lK)
---------------------------------------------------------------------
DNV-X    Det Norske Veritas X-curve (Units: N/m**2)

         First      4.100  3.400E+07   8.301  39.180  39.980   0.400
         Second   Horisontal tail

         Thickness correction: None

DNVX     DNV-X curve in N/mm2

         First      4.100  3.400E+01   8.301  14.580  15.380   0.400
         Second   Horisontal tail

         Thickness correction: None
```

PRINT STARTING-POINT

<table>
<tr><td rowspan="2">...</td><td rowspan="2">STARTING-POINT</td><td colspan="2">event+</td></tr>
<tr><td>VARIABLE</td><td>variable+</td></tr>
</table>

PURPOSE:

Print assigned starting points.

PARAMETERS:

event	A selection of events with starting point assigned.
VARIABLE	Print starting point for one or more variables.
variable+	A selection of variables with starting point assigned.

NOTES:

See also:

- ASSIGN STARTING-POINT
- DEFINE FORM-SORM STARTING-POINT INITIAL
- SELECT RESULT
- SET TITLE

EXAMPLES:

```
PRINT STARTING-POINT J5120-CGFail
```

PRINT TRANSFER-FUNCTION

...	TRANSFER-FUNCTION	name+	dir+

PURPOSE:

Print one or more transfer functions at one or more directions.

PARAMETERS:

name+	Name(s) of transfer function(s) to be printed.
dir+	Selection of directions for which the function(s) is printed.

NOTES:

Illegal combinations of transfer function names and directions are ignored.

See also:

- CREATE TRANSFER-FUNCTION
- CHANGE TRANSFER-FUNCTION
- DISPLAY TRANSFER-FUNCTION

EXAMPLES:

```
PRINT TRANSFER-FUNCTION TRF* ( 0 45 )
```

PRINT UNCERTAINTY

...	UNCERTAINTY	DEFINITION	...
		VALUE	...

PURPOSE:

Print uncertainty definition and settings.

PARAMETERS:

DEFINITION	Print the uncertainty definitions.
VALUE	Print assigned uncertainty values.

NOTES:

All sub-commands and data are fully explained on the following pages.

PRINT UNCERTAINTY DEFINITION

<table>
<tr><td rowspan="2">...</td><td rowspan="2">DEFINITION</td><td>DESCRIPTION</td><td rowspan="2">name+</td></tr>
<tr><td>OVERVIEW</td></tr>
</table>

PURPOSE:

Print uncertainty definitions.

PARAMETERS:

DESCRIPTION	Print the full description of the uncertainty definition.
OVERVIEW	Print an overview (one line) of the uncertainty definition.
name+	The name of one or more parameter types, to which uncertainty can be applied.

NOTES:

Each parameter type (e.g. the width of the of the plate in which the fatigue point sits) has a default safety level definition and uncertainty definition. These definitions are printed by use of this command.

See also:

- ASSIGN UNCERTAINTY VALUE
- DEFINE UNCERTAINTY

EXAMPLE:

```
PRINT UNCERTAINTY DEFINITION OVERVIEW Inspection*
```

may generate the following print:

```
Parameter                     Description                      Distribution
-------------------------------------------------------------------------
Inspection-Depth              Depth of crack at inspection     Exponential
Inspection-Grind              Depth of grind at inspection     Exponential
Inspection-Length             Length of crack at inspection    Exponential
Inspection-Thick              Thickness after repair           Normal
Inspection-Time               Time of inspection               Normal
```

PRINT UNCERTAINTY DEFINITION DESCRIPTION Inspection-Length

may generate the following print:

```
Parameter                     Content      Value
-----------------------------------------------------------------------------
Inspection-Length             Description  Length of crack at inspection
                              Distribution Exponential,  0.0
                              Default      Uncertainty: None
```

```
Safety level: Margin 0.0
```

PRINT UNCERTAINTY VALUE

...	VALUE	name+

PURPOSE:

Print assigned uncertainty values.

PARAMETERS:

name+ The name of one or more parameters, that can have uncertainty assigned (See note 1 below). Such a parameter has its own name, if it is a global parameter (e.g. Final-Time or a derived name if it belongs to a named object. The derived name is composed of the name of the object (e.g. MEMB3501) and an identification of the parameter (e.g. Width), connected by a hyphen (e.g. MEMB3501-Width).

NOTES:

1 All parameters that can have safety level and uncertainty assigned are documented with the commands where they are being used.

2 The uncertainty representation is stored in a variable, with the same name as the parameter, but truncated to 12 characters (e.g. MEMB3501-Wid).

3 The variable associated with the parameter can be examined using the commands PRINT VARIABLE, PRINT DISTRIBUTION and DISPLAY DISTRIBUTION.

4 Each parameter type (e.g. the width of the of the plate in which the fatigue point sits) has a default uncertainty definition. This definition consists of a random distribution (e.g. Normal), and definition of LOW, MEDIUM and HIGH uncertainty in terms of standard deviation and/or coefficient of variation (when both of these are specified, the one that generates the highest standard deviation for a given mean value takes effect). The mean value of the variable will be the input value of the parameter. All available parameter types can be printed by use of the command PRINT UNCERTAINTY DEFINITION OVERVIEW. The default distribution and uncertainty can be printed by use of PRINT UNCERTAINTY DEFINITION DESCRIPTION.

See also:

- ASSIGN UNCERTAINTY VALUE
- DEFINE UNCERTAINTY
- PRINT UNCERTAINTY DEFINITION

EXAMPLE:

```
PRINT UNCERTAINTY VALUE J3220*
```

may generate the following print:

```
Parameter         Type      Uncertainty value
--------------------------------------------------------------------------------
J3220-1dB         None      0.881152 (no uncertainty)
J3220-a0          Known     Exponential(Mean-Low: 0.1, 0.0)
J3220-acRatio     CoV       Normal(Mean-CoV: 0.1, 0.1)
J3220-acrit       None      20.0 (no uncertainty)
J3220-ASCF        Medium    Normal(Mean-CoV: 2.5, 5.0E-02)
J3220-aTRF        None      1.0 (no uncertainty)
J3220-bTRF        None      0.0 (no uncertainty)
J3220-cTRF        None      0.0 (no uncertainty)
J3220-GFactor     CoV       Normal(Mean-CoV: 0.486663, 0.1)
J3220-IFactor     None      1.0 (no uncertainty)
J3220-ISCF        Medium    Normal(Mean-CoV: 3.53553, 5.0E-02)
J3220-ITime       None      0.0 (no uncertainty)
J3220-lN0         Medium    Normal(Mean-CoV: 8.301, 5.0E-02)
J3220-lnA         Stdv      Normal(Mean-StD: 2.9032, 3.19641E-02)
J3220-lnC         Stdv      Normal(Mean-StD: -31.0, 0.77)
J3220-m0          Low       Normal(Mean-CoV: 4.1, 1.0E-02)
J3220-MinerSum    High      Normal(Mean-CoV: 1.0, 0.1)
J3220-MSRatio     None      0.2 (no uncertainty)
J3220-m           None      3.5 (no uncertainty)
J3220-nu0         Medium    Normal(Mean-CoV: 0.127833, 5.0E-02)
J3220-ODiam       None      700.0 (no uncertainty)
J3220-OSCF        Medium    Normal(Mean-CoV: 3.53553, 5.0E-02)
J3220-RSP         None      1.0 (no uncertainty)
J3220-SFactor     None      1.0 (no uncertainty)
J3220-Thick       None      20.0 (no uncertainty)
```

PRINT VARIABLE

...	VARIABLE	name+

PURPOSE:

Print information about one or more variables.

PARAMETERS:

name+ Name(s) of variable(s) to be printed.

NOTES:

The printout contains information about the variable data, including all assignments except starting point and correlation.

See also:

- CHANGE VARIABLE
- CREATE VARIABLE
- DISPLAY VARIABLE
- ASSIGN CONDITIONING
- ASSIGN EXTREME-VALUE
- ASSIGN FUNCTION-OPTION
- ASSIGN OPTIMISATION-BOUNDS
- ASSIGN SENSITIVITY-CALCULATION
- SET TITLE

EXAMPLES:

```
PRINT VARIABLE ( J3220-lnC J3220-m )
```

May generate the following print:

```
                              +----------------------------+
                              !         Variable           !
                              +----------------------------+
                              !         J3220-lnC          !
                              ! ln(C), material parameter  !
                              +----------------------------+

Type          Name              Dim Parameter    Value                          Sens
```

```
---------------------------------------------------------------------------
Distribution Normal           1 Mean          -31.0                    Off
                                Stand-Dev     0.77                     Off

Calculated parameters:          Skewness      0.0
                                Kurtosis      3.0
                                Median        -31.0


                            +------------------------+
                            !        Variable        !
                            +------------------------+
                            !         J3220-m        !
                            ! m, material parameter !
                            +------------------------+

Type          Name            Dim Parameter     Value                     Sens
---------------------------------------------------------------------------
Fixed                                           3.5
```

PRINT WAVE-SPREADING-FUNCTION

...	WAVE-SPREADING-FUNCTION	name	[space]

PURPOSE:

Print information about one wave spreading function.

PARAMETERS:

name	Name of a wave spreading function.
space	Space between each wave direction angle for which the function is displayed. This value is independent of what the program will use in calculations. This value is only required when a cosine power function is displayed.

NOTES:

See also:

- CREATE WAVE-SPREADING-FUNCTION
- CHANGE WAVE-SPREADING-FUNCTION
- DISPLAY WAVE-SPREADING-FUNCTION

EXAMPLES:

```
PRINT WAVE-SPREADING-FUNCTION COS2 30
```

may generate the following print:

```
Name      Direction   Weight   Description
-----------------------------------------------------------------------
COS2       -90.000   3.756E-03 ANALYTICAL COS**2
           -60.000   8.709E-02
           -30.000   2.462E-01
             0.000   3.258E-01
            30.000   2.462E-01
            60.000   8.709E-02
            90.000   3.756E-03
```

PRINT WAVE-STATISTICS

...	WAVE-STASTICS	name+

PURPOSE:

Print information about a selection of wave statistics.

PARAMETERS:

name+ Name(s) of a wave statistics to be printed.

NOTES:

Any assigned wave spreading function and wave spectrum shape is printed also.

See also:

- CREATE WAVE-STATISTICS
- CHANGE WAVE-STATISTICS
- ASSIGN WAVE-PSREADING-FUNCTION
- ASSIGN WAVE-SPECTRUM-SHAPE

EXAMPLES:

```
PRINT WAVE-STATISTICS SCATTER
```

may generate the following print:

```
Name:       SCATTER
Decription: ARBITRARY DATA

   Hs        Tz       Prob    Typ L-param N-param  Gamma   SigmaA SigmaB WaveSpr
------------------------------------------------------------------------------
1.750E+03   4.750 2.490E-01 P-M                                      COS2
1.750E+03   7.750 8.600E-02
1.250E+03   6.250 2.360E-01
3.250E+03   6.250 2.060E-01
4.750E+03   7.750 1.170E-01
4.750E+03   7.750 1.060E-01

Total probability: 1.0
```

RENAME

RENAME	EVENT	...
	FUNCTION	...
	RESULT	...
	VARIABLE	...

PURPOSE:

Rename a named object.

PARAMETERS:

EVENT	Rename an event.
FUNCTION	Rename a function.
RESULT	Rename an analysis result.
VARIABLE	Rename a random variable.

NOTES:

None.

RENAME EVENT

...	EVENT	from	to

PURPOSE:

To change the name of an event.

PARAMETERS:

from	The original name of the event.
to	The new name of the event. This cannot be the name of an existing event.

NOTES:

Renaming of an event does not affect the usage of the event in other events.

See also:

- CHANGE EVENT
- CREATE EVENT
- DELETE EVENT
- COPY EVENT
- PRINT EVENT
- DISPLAY EVENT

EXAMPLES:

```
RENAME EVENT Moment-1 Moment-2
```

RENAME FUNCTION

...	FUNCTION	from	to

PURPOSE:

To change the name of a function formula or function integral.

PARAMETERS:

from	The original name of the function.
to	The new name of the function. This cannot be the name of an existing function.

NOTES:

If the renamed function is referenced in other function formulas or function integrals, then the name must be changed in these functions too.

See also:

- CHANGE FUNCTION
- CREATE FUNCTION
- DELETE FUNCTION
- PRINT FUNCTION
- DISPLAY FUNCTION

EXAMPLES:

```
RENAME FUNCTION SYMFUN SYMFOR
```

RENAME RESULT

...	RESULT	from	to

PURPOSE:

To change the name of a result.

PARAMETERS:

from	The original name of the result.
to	The new name of the result. This cannot be the name of an existing result.

NOTES:

See also:

- SAVE RESULT
- DELETE RESULT
- RUN
- PRINT RESULT
- DISPLAY RESULT

EXAMPLES:

```
RENAME RESULT SORM-Result Global-Fail
```

RENAME VARIABLE

...	VARIABLE	from	to

PURPOSE:

To change the name of a variable.

PARAMETERS:

from	The original name of the variable.
to	The new name of the variable. This cannot be the name of an existing variable.

NOTES:

Renaming a variable does not affect the usage of the variable in other variables or in single events, nor does it affect any correlation assignments.

See also:

- CHANGE VARIABLE
- CREATE VARIABLE
- DELETE VARIABLE
- COPY VARIABLE
- PRINT VARIABLE
- DISPLAY VARIABLE

EXAMPLES:

```
RENAME VARIABLE Width1 Width2
```

RUN

RUN	CALIBRATION-CRACK-GROWTH	...
	CRACK-GROWTH-ANALYSIS	...
	DETERMINISTIC-ANALYSIS	...
	DISTRIBUTION-ANALYSIS	...
	INPUT-CHECK	...
	PLAN-INSPECTION	...
	PROBABILITY-ANALYSIS	...
	RESTART	...
	SN-ANALYSIS	...

PURPOSE:

Run an analysis.

PARAMETERS:

CALIBRATION-CRACK-GROWTH	Calibrate the crack growth reliability curve to the SN reliability curve.
CRACK-GROWTH-ANALYSIS	Run a crack growth analysis.
DETERMINISTIC-ANALYSIS	Run a deterministic analysis.
DISTRIBUTION-ANALYSIS	Run an analysis of the distribution of a variable.
INPUT-CHECK	Check the input for a probability analysis or distribution analysis.
INSPECTION-ANALYSIS	Run an analysis of the probability of failure for a fatigue point throughout the service life, taking all inspections into account.
PLAN-INSPECTION	Calculate an inspection plan for a selection of fatigue points.
PROBABILITY-ANALYSIS	Run an analysis of the probability of an event, possibly conditioned on another event, or of the probability of failure for a fatigue point throughout the service life.
SN-ANALYSIS	Run an SN analysis.
RESTART	Restart a probability or distribution simulation from the results obtained.

NOTES:

None.

RUN CALIBRATION-CRACK-GROWTH

...	CALIBRATION-CRACK-GROWTH	fatigpnt/inspect	param+

PURPOSE:

Run a calibration of the crack growth model to the SN reliability result.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection with a repair assigned.
param+	A selection of parameters that are to be adjusted in order to make the calibration. Up to three parameters can be used. The available parameters are a subset of all parameters defining the crack growth model.

NOTES:

1 The selected parameters will be adjusted, by use of sensitivity results from the probability analysis of the crack growth model, to provide reliability indexes as close as possible to those calculated from the SN analysis at the chosen time points.

2 The calibration always uses the FORM analysis method.

3 The command DEFINE CALIBRATION-CRACK-GROWTH is used to set options for the calibration and the times at which the calibration is performed.

4 After an inspection with repair assigned, calibration is performed on the unconditional failure probability, not conditioned on the previous inspection result(s).

See also:

- DEFINE CALIBRATION-CRACK-GROWTH
- DISPLAY CALIBRATION-CRACK-GROWTH
- PRINT CALIBRATION-CRACK-GROWTH
- ASSIGN CRACK-GROWTH-MODEL
- ASSIGN GEOMETRY-FUNCTION
- ASSIGN WELD-EFFECT

EXAMPLE:

```
RUN CALIBRATION-CRACK-GROWTH C3501 ( C3501-lnC-Mean C3501-Gfactor )
```

RUN CRACK-GROWTH-ANALYSIS

<table>
<tr><td rowspan="4">...</td><td rowspan="4">CRACK-GROWTH-ANALYSIS</td><td>FAILURE-PROB</td><td colspan="2">fatigpnt/inspect</td></tr>
<tr><td rowspan="2">LIFE-TIME</td><td rowspan="2">fatigpnt/inspect</td><td>DETERMINISTIC</td></tr>
<tr><td>PROBABILISTIC</td></tr>
<tr><td>UPDATE-MODEL</td><td colspan="2">fatigpnt/inspect</td></tr>
</table>

PURPOSE:

Run a crack growth analysis.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection with a repair assigned.
FAILURE-PROBABILITY	Analyse the probability of failure as a function of time.
LIFE-TIME	Calculate the time to failure, either DETERMINISTIC (i.e. as a single value) or PROBABILISTIC (i.e. as a distribution).
UPDATE-MODEL	Update all variables and events that are used in either a failure probability analysis or a probabilistic life time analysis.

NOTES:

1 The update option may be used to ensure that the variables and events contain the last updated information about the fatigue point or inspection with all following inspections. These variables and events may then be used for analysis executed by the user.

2 The failure probability analysis calculates the failure probability (and the reliability) as a function of time, from the start of the service life (for a fatigue point) or from the inspection time (for an inspection). All inspections after the starting point are taking into account during the analysis when needed.

See also:

- DEFINE CRACK-GROWTH-ANALYSIS
- DISPLAY CRACK-GROWTH-ANALYSIS
- PRINT CRACK-GROWTH-ANALYSIS
- RUN PROBABILITY-ANALYSIS
- RUN DISTRIBUTION-ANALYSIS
- RUN DETERMINISTIC-ANALYSIS

EXAMPLE:

```
RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120
```

RUN DETERMINISTIC-ANALYSIS

...	DETERMINISTIC-ANALYSIS	...

<table>
<tr><td rowspan="5">...</td><td rowspan="3">VARIABLE</td><td rowspan="3">variable</td><td colspan="6">MEAN-VALUE</td></tr>
<tr><td colspan="6">MEDIAN-VALUE</td></tr>
<tr><td>MODIFIED</td><td>MEAN-BASED
MEDIAN-BASED</td><td>{</td><td>name</td><td>value</td><td>}*</td></tr>
<tr><td rowspan="2">EVENT</td><td rowspan="2">event</td><td colspan="6">STARTING-POINT</td></tr>
<tr><td colspan="6">USPACE-ORIGIN</td></tr>
</table>

PURPOSE:

Run a deterministic analysis.

PARAMETERS:

VARIABLE	Calculate the value of a variable.
variable	The name of the variable for which the analysis is made.
MEAN-VALUE	Use the mean value of all distribution variables (the median will be used if the mean cannot be calculated).
MEDIAN-VALUE	Use the median value (50% fractile) of all distributions.
MODIFIED	Use the mean or median as basis.
MEAN-BASED	Use the mean value of all distribution variables as basis, excepting the specified modifications (the median will be used if the mean cannot be calculated).
MEDIAN-BASED	Use the median value (50% fractile) of all distributions as basis, excepting the specified modifications.
{name, value}*	Input of values that are to overwrite values specified elsewhere. Name is a one-dimensional variable of distribution type and value is either a single numerical value or -fracxx, the fractile at xx% probability level, followed by a numerical value. The -frac is case insensitive. Notice the preceding hyphen.
EVENT	Calculate the limit state value of an event. The limit state value is: left hand side - right hand side for a single event, minimum of all subevent values for an intersection, maximum of all subevent values for a union.Conditional events cannot be used here.
event	The name of the event for which an analysis is made.

STARTING-POINT	Use the starting point for the event, if assigned. If no starting point is assigned, the default starting point is used.
USPACE-ORIGIN	Calculate the value at the U-space origin (identical to the median values).

NOTES:

1 The result is stored under the name “LastAnalysis” and is overwritten the next time an analysis is performed unless saved under another name using the SAVE RESULT command.

2 The results are examined by use of the commands PRINT RESULT or DISPLAY RESULT.

See also:

- ASSIGN STARTING-POINT
- SAVE RESULT
- PRINT RESULT
- DISPLAY RESULT

EXAMPLES:

```
RUN DETERMINISTIC-ANALYSIS VARIABLE P-SNTime MEAN-VALUE
```

RUN DISTRIBUTION-ANALYSIS

<table>
<tr><td rowspan="2">...</td><td rowspan="2">DISTRIBUTION-ANALYSIS</td><td colspan="3">1d-variable</td></tr>
<tr><td>CONDITIONED</td><td>1d-variable</td><td>...</td></tr>
</table>

<table>
<tr><td rowspan="2">...</td><td colspan="4">event</td></tr>
<tr><td>SINGLE-EVENT</td><td>1d-condvar</td><td>IN(EQ)</td><td>threshold</td></tr>
</table>

PURPOSE:

Run a distribution analysis.

PARAMETERS:

1d-variable	The name of a one-dimensional variable (can be a coordinate of a multidimensional variable).
CONDITIONED	Analyse the conditioned distribution of 1d-variable given an event.
event	The name of the conditioning event. This event cannot be of the conditioned type.
SINGLE-EVENT	The conditioning event is specified directly as a simple (in)equality.
1d-condvar	The name of the one dimensional variable that is forming the left hand side if the (in)equality.
(IN)EQ	The type of (in)equality. One of: <, = and >
threshold	The numerical right hand side of the conditioning single event.

NOTES:

1 The type of analysis being run is selected by use of the SELECT ANALYSIS-METHOD DISTRIBUTION-ANALYSIS command. The options to be used for the analysis are set by use of the DEFINE command.

2 The result is stored under the name “LastAnalysis” and is overwritten the next time an analysis is performed unless saved under another name using the SAVE RESULT command.

3 The results are examined by use of the commands PRINT RESULT or DISPLAY RESULT.

See also:

- DEFINE DISTRIBUTION-SIMULATION
- DEFINE MEAN-VALUE-FORM
- DEFINE PARAMETER-STUDY

- SELECT ANALYSIS-METHOD DISTRIBUTION-ANALYSIS
- SAVE RESULT

EXAMPLE:

```
RUN DISTRIBUTION-ANALYSIS NPV
RUN DISTRIBUTION-ANALYSIS CONDITIONED NPV SINGLE-EVENT Expense 100000
```

RUN INPUT-CHECK

...	INPUT-CHECK	DISTRIBUTION-ANALYSIS
		PROBABILITY-ANALYSIS

PURPOSE:

Run a check of the input to an analysis.

PARAMETERS:

DISTRIBUTION-ANALYSIS	Run a check of an analysis of the distribution of a variable.
PROBABILITY-ANALYSIS	Run a check of an analysis of the probability of an event, possibly conditioned on another event.

NOTES:

The sub-commands are identical in syntax to RUN DISTRIBUTION-ANALYSIS and RUN PROBABILITY-ANALYSIS. The only difference is that they only check the input to the analysis, they do not run the analysis.

RUN PLAN-INSPECTION

...	PLAN-INSPECTIONNING	fatigpnt+	start	name	descr

PURPOSE:

Compute an inspection plan for a selection of fatigue points.

PARAMETERS:

fatigpnt+	The name(s) of the fatigue point(s) for which the plan is made.
start	The start time for the plan. The plan will continue to the end of the service life.
name	The name under which the inspection plan is stored.
descr	A descriptive text for the inspection plan.

NOTES:

The command DEFINE PLAN-INSPECTION is used to define the way the planning is performed.

See also:

- DEFINE PLAN-INSPECTION
- DISPLAY PLAN-INSPECTION
- PRINT PLAN-INSPECTION

EXAMPLE:

```
DEFINE PLAN-INSPECTIONNING PRESCRIBED GROUP 4 32 4
RUN PLAN-INSPECTIONNING * FourYearPlan 'Prescribed inspection every four years'
DEFINE PLAN-INSPECTIONNING OPTIMISED
RUN PLAN-INSPECTIONNING C35* C35Opt 'Optimised inspection for all C35 points'
```

RUN PROBABILITY-ANALYSIS

...	PROBABILITY-ANALYSIS	event			
		SINGLE-EVENT	1d-variable	< , = , >	threshold
		CONDITIONED	...		

...	event	...		
	SINGLE-EVENT	1d-variable	< , = , >	threshold

...	conditioning event			
	SINGLE-EVENT	1d-variable	< , = , >	threshold

PURPOSE:

Run a probability analysis.

PARAMETERS:

event	The name of the event to be analysed.
SINGLE-EVENT	The event is specified directly as a simple (in)equality.
1d-variable	The name of a one-dimensional variable (can be a coordinate of a multidimensional variable).
< , = , >	One of: < less than, = equal, > greater than.
threshold	The numerical right hand side of the single event.
CONDITIONED	Analyse the conditioned probability of one event given another.
conditioning event	The name of the conditioning event. This event cannot be of the conditioned type.

NOTES:

1 The type of analysis being run is selected by use of the SELECT ANALYSIS-METHOD PROBABILITY-ANALYSIS command. The options to be used for the analysis are set by use of the DEFINE command.

2 The result is stored under the name “LastAnalysis” and is overwritten the next time an analysis is performed unless saved under another name using the SAVE RESULT command.

3 The results are examined by use of the commands PRINT RESULT or DISPLAY RESULT.

See also:

- DEFINE ANALYSIS-OPTION
- DEFINE FORM-SORM
- DEFINE PROBABILITY-SIMULATION
- DEFINE PARAMETER-STUDY
- SELECT ANALYSIS-METHOD PROBABILITY-ANALYSIS
- SAVE RESULT
- PRINT RESULT
- DISPLAY RESULT

EXAMPLES:

```
RUN PROBABILITY-ANALYSIS Beam-Fail
RUN PROBABILITY-ANALYSIS SINGLE-EVENT NPV > 100000
RUN PROBABILITY-ANALYSIS CONDITIONED Failure NoFind
RUN PROBABILITY-ANALYSIS CONDITIONED Loss SINGLE-EVENT Expense > 100000
```

RUN RESTART

...	RESTART

PURPOSE:

Continue a simulation.

PARAMETERS:

None.

NOTES:

1 The selected result defines the analysis to be restarted.

2 Only simulation resulting from RUN PROBABILITY-ANALYSIS or RUN DISTRIBUTION-ANALYSIS can be restarted. The simulation will add to the previously established sample. The stop criteria for the simulation can be modified before the analysis is restarted.

3 The new result will be stored under the default name “LastAnalysis”. The previous result is deleted if it was also stored under this name.

See also:

- RUN DISTRIBUTION-ANALYSIS
- RUN PROBABILITY-ANALYSIS
- DEFINE DISTRIBUTION-SIMULATION
- DEFINE PROBABILITY-SIMULATION
- SAVE RESULT
- PRINT RESULT
- DISPLAY RESULT

EXAMPLE:

```
RUN RESTART
```

RUN SN-ANALYSIS

<table>
<tr><td rowspan="4">...</td><td rowspan="4">SN-ANALYSIS</td><td>FAILURE-PROBABILITY</td><td colspan="2">fatigpnt/inspect</td></tr>
<tr><td rowspan="2">LIFE-TIME</td><td rowspan="2">fatigpnt/inspect</td><td>DETERMINISTIC</td></tr>
<tr><td>PROBABILISTIC</td></tr>
<tr><td>UPDATE-MODEL</td><td colspan="2">fatigpnt/inspect</td></tr>
</table>

PURPOSE:

Run an SN analysis.

PARAMETERS:

fatigpnt/inspect	The name of a fatigue point or an inspection with a repair assigned.
FAILURE-PROBABILITY	Analyse the probability of failure as a function of time.
LIFE-TIME	Calculate the time to failure, either DETERMINISTIC (i.e. as a single value) or PROBABILISTIC (i.e. as a distribution).
UPDATE-MODEL	Update all variables and events that are used in either a failure probability analysis or a probabilistic life time analysis.

NOTES:

1 The update option may be used to ensure that the variables and events contain the last updated information about the fatigue point or inspection. These variables and events may then be used for analysis executed by the user.

2 The failure probability analysis maps the failure probability (and the reliability) as a function of time, from the start of the service life (for a fatigue point) or from the inspection time (for an inspection).

See also:

- DEFINE SN-ANALYSIS
- DISPLAY SN-ANALYSIS
- PRINT SN-ANALYSIS
- RUN PROBABILITY-ANALYSIS
- RUN DISTRIBUTION-ANALYSIS
- RUN DETERMINISTIC-ANALYSIS

EXAMPLE:

```
RUN SN-ANALYSIS FAILURE-PROBABILITY J5120
```

SAVE

SAVE	RESULT	...

PURPOSE:

Save an analysis result under a name.

PARAMETERS:

RESULT	Save an analysis result.

NOTES:

None.

SAVE RESULT

...	RESULT	name	desc

PURPOSE:

Save a result under a name.

PARAMETERS:

name	Name of the result. This cannot be the name of an existing result. Result names are matched case insensitively and can not be longer than 12 characters.
desc	Descriptive text for the result. It can be up to 50 characters long.

NOTES:

1 Only results from RUN DETERMINISTIC-ANALYSIS, RUN PROBABILITY-ANALYSIS and RUN DISTRIBUTION-ANALYSIS can be saved using this command. These results are by default stored under the name “LastAnalysis” and will be overwritten by the next analysis if they are not saved.

2 The results created by this program should not be modified by the user.

See also:

- RUN DISTRIBUTION-ANALYSIS
- RUN PROBABILITY-ANALYSIS
- DELETE RESULT
- RENAME RESULT
- DISPLAY RESULT
- PRINT RESULT

EXAMPLES:

```
SAVE RESULT Fail-444S 'SORM: Failure of joint 444'
```

SELECT

SELECT	ANALYSIS-METHOD	...
	FUNCTION-LIBRARY	...
	RESULT	...

PURPOSE:

Select objects or methods for use in other commands.

PARAMETERS:

ANALYSIS-METHOD	Select a method for use in probability and distribution analysis.
FUNCTION-LIBRARY	Select the function libraries to be available in other commands.
RESULT	Select the result to be used for presentation (PRINT or DISPLAY).

NOTES:

None.

SELECT ANALYSIS-METHOD

<table>
<tr><td rowspan="11">...</td><td rowspan="11">ANALYSIS-METHOD</td><td rowspan="3">DISTRIBUTION-ANALYSIS</td><td colspan="2">MONTE-CARLO-SIMULATION</td></tr>
<tr><td colspan="2">LATIN-HYPERCUBE-SIMULATION</td></tr>
<tr><td colspan="2">MEAN-VALUE-FORM</td></tr>
<tr><td rowspan="8">PROBABILITY-ANALYSIS</td><td colspan="2">FORM</td></tr>
<tr><td rowspan="4">SORM</td><td>PARABOLIC</td></tr>
<tr><td>DIAGONAL</td></tr>
<tr><td>FULL-EXPANSION</td></tr>
<tr><td>ASYMPTOTIC</td></tr>
<tr><td colspan="2">AXIS-ORTHOGONAL-SIMULATION</td></tr>
<tr><td colspan="2">DIRECTIONAL-SIMULATION</td></tr>
<tr><td colspan="2">MONTE-CARLO-SIMULATION</td></tr>
</table>

PURPOSE:

Select analysis method for probability and distribution analyses.

PARAMETERS:

DISTRIBUTION-ANALYSIS	Select the method used for distribution analysis.
MONTE-CARLO-SIMULATION	The simplest simulation method where points are picked randomly and sample values are kept (distribution analysis) or the frequency of occurrences counted (probability analysis).
LATIN-HYPERCUBE-SIMULATION	A stratified simulation technique where the sampling points are spread systematically over the sample space.
MEAN-VALUE-FORM	A simple FORM estimation of a distribution. Quick, but not generally reliable.
PROBABILITY-ANALYSIS	Select the method used for probability analysis.
FORM	First Order Reliability method.
SORM	Second Order Reliability Method.
PARABOLIC	Uses a parabolic approximation to the failure surface. If the U-space dimension is n, this method requires $(n-1)^2$ second order derivations.

DIAGONAL	Uses an approximation to the failure surface based on the diagonal of the second order differential matrix. If the U-space dimension is n, this method requires n second order derivations.
FULL-EXPANSION	Uses a full second order approximation to the failure surface. If the U-space dimension is n, this method requires n^2 second order derivations. Note that this method is not invariable wt. different formulations of the problem that give the same failure surface.
ASYMPTOTIC	Asymptotic second order approximation. Not necessarily accurate, but fast.
DIRECTIONAL-SIMULATION	Directional simulation of a probability. Samples directions in U-space instead of points.
AXIS-ORTHOGONAL-SIMULATION	A simulation method based on a FORM result. It simulates the difference between the correct probability and the FORM approximation.

NOTES:

1 The current analysis selection may be printed by use of the PRINT ANALYSIS-SETTINGS command.

2 Both a probability and a distribution analysis method is selected at the same time.

See also:

- PRINT ANALYSIS-SETTINGS
- DEFINE ANALYSIS-OPTIONS
- DEFINE DISTRIBUTION-SIMULATION
- DEFINE MEAN-VALUE-FORM
- DEFINE DISTRIBUTION-SIMULATION
- DEFINE PROBABILITY-SIMULATION
- RUN PROBABILITY-ANALYSIS
- RUN DISTRIBUTION-ANALYSIS
- DEFINE CRACK-GROWTH-ANALYSIS FAILURE PROBABILITY ANALYSIS-METHOD
- DEFINE SN-ANALYSIS FAILURE-PROBABILITY ANALYSIS-METHOD

EXAMPLE:

The following values are default when the program starts up with a new database:

```
SELECT ANALYSIS-METHOD PROBABILITY-ANALYSIS FORM
```

```
SELECT ANALYSIS-METHOD DISTRIBUTION-ANALYSIS MONTE-CARLO-SIMULATION
```

SELECT FUNCTION-LIBRARY

...	FUNCTION-LIBRARY	name+

PURPOSE:

Select one or more function libraries in order to limit the selection of functions presented in other commands.

PARAMETERS:

name+ A selection of function library names.

NOTES:

1 This command serves to mask off some function libraries temporarily. This can be useful as some function libraries may have a large number of functions and/or be irrelevant for the current modelling.

2 The program starts on a new database with two libraries masked off: “Distribution” and “Verification”.

See also:

- PRINT FUNCTION
- CREATE VARIABLE ... FUNCTION
- CHANGE VARIABLE ... FUNCTION

EXAMPLES:

```
SELECT FUNCTION-LIBRARY *
```

SELECT RESULT

...	RESULT	name

PURPOSE:

Select a result from probability or distribution analysis for presentation.

PARAMETERS:

name	The name of a result.

NOTES:

Only one result from probability analysis or distribution analysis can be presented at one time. Other types of result presentations are not affected by this command.

See also:

- PRINT RESULT
- DISPLAY RESULT
- DELETE RESULT
- RUN PROBABILITY-ANALYSIS
- RUN DISTRIBUTION-ANALYSIS
- SAVE RESULT

EXAMPLES:

```
SELECT RESULT Fail-444S
```

SET

SET	COMPANY-NAME	...
	DISPLAY	...
	DRAWING	...
	GRAPH	...
	PLOT	...
	PRINT	...

PURPOSE:

Set or reset global file and device environment characteristics.

PARAMETERS:

COMPANY-NAME	Set company name on display and plot.
DISPLAY	Set display characteristics.
DRAWING	Set drawing characteristics.
GRAPH	Set graph characteristics.
PLOT	Set plot file characteristics.
PRINT	Set print characteristics.

NOTES:

All sub-commands and data are fully explained subsequently as each command is described in detail.

SET COMPANY-NAME

...	COMPANY-NAME	text

PURPOSE:

To set the company name for use with result presentation.

PARAMETERS:

text The name of the company.

NOTES:

The text is used at the top of a display or a plot. It is not used with printed results.

See also:

- DISPLAY
- PLOT

EXAMPLES:

```
SET COMPANY-NAME 'Det Norske Veritas'
```

SET DISPLAY

...	DISPLAY	COLOUR	ON			
			OFF			
		DESTINATION	FILE			
			SCREEN			
		DEVICE	device			
		WORKSTATION-WINDOW	left	right	bottom	top

PURPOSE:

Set display characteristics.

PARAMETERS:

COLOUR	Sets the output to the display device to be in colours (ON) or monochrome (OFF).
DESTINATION	Set the destination of the graphics produced in the DISPLAY command to the current plot file (FILE) or to the screen (SCREEN).
DEVICE	Set the current screen display device type. The available device types depend on the computer on which the program runs. Here is a selection of the some device types that may be available: VGA PC with VGA resolution, X-WINDOW for X windows, VT340 (Digital VT 340 screen), DUMMY used to dump display output to nowhere.
WORKSTATION-WINDOW	Set the size and position of the display window when using a workstation device. This command will only be taken into account if issued prior to any DISPLAY command. Otherwise, the settings will not be valid until the user has exited from Proban and entered again. Please note that the window can be re-sized using the mouse under X Windows.
left	Position of left display window border.
right	Position of right display window border.
bottom	Position of bottom display window border.
top	Position of top display window border.

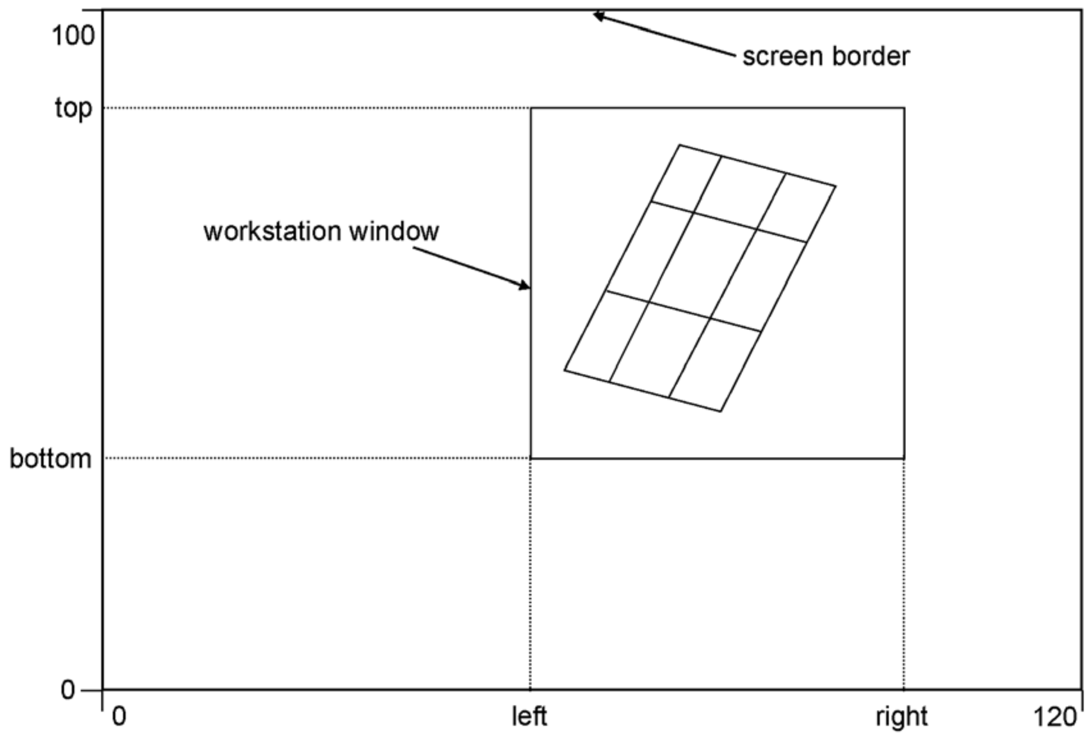


Figure 5.3 Setting the initial size of a workstation window

NOTES:

1 The destination is always set to SCREEN when the program starts up, also with an existing database.

2 The DUMMY device is useful for effectively disabling all DISPLAY commands in a command input file, when the displays themselves are not needed.

See also:

- DISPLAY
- PLOT

EXAMPLES:

The following is default when the program starts with a new database:

```
SET DISPLAY COLOUR ON
```

```
SET DISPLAY DESTINATION SCREEN
SET DISPLAY WORKSTATION-WINDOW <To be completed>
```

The default DEVICE depends on the computer system.

SET DRAWING

<table>
<tr><td rowspan="11">...</td><td rowspan="11">DRAWING</td><td rowspan="2">CHARACTER-TYPE</td><td colspan="2">HARDWARE</td></tr>
<tr><td colspan="2">SOFTWARE</td></tr>
<tr><td rowspan="2">FONT-SIZE</td><td>ABSOLUTE</td><td>size</td></tr>
<tr><td>RELATIVE</td><td>factor</td></tr>
<tr><td rowspan="5">FONT-TYPE</td><td colspan="2">SIMPLE</td></tr>
<tr><td colspan="2">GROTESQUE</td></tr>
<tr><td colspan="2">ROMAN-NORMAL</td></tr>
<tr><td colspan="2">ROMAN-ITALIC</td></tr>
<tr><td colspan="2">ROMAN-BOLD</td></tr>
<tr><td>FRAME</td><td colspan="2">ON/OFF</td></tr>
<tr><td>GRID</td><td colspan="2">ON/OFF</td></tr>
</table>

PURPOSE:

To set drawing characteristics.

PARAMETERS:

CHARACTER-TYPE	Set the character type to SOFTWARE (i.e. scalable) or HARDWARE (i.e. fixed).
FONT-SIZE	Set the font size. This affects all text.
ABSOLUTE size	Set the font size to an ABSOLUTE size in mm.
RELATIVE factor	Set the font size to a RELATIVE value scalable by a factor, where 40*80 characters are fitted into the window when the factor is 1.
FONT-TYPE	Select the font to be used. The list of fonts may be machine dependent.
FRAME ON/OFF	Set frame on drawing ON or OFF. This command has currently no effect.
GRID ON/OFF	Set grid on a graph drawing ON or OFF.

NOTES:

See also:

- DISPLAY

- PLOT

EXAMPLES:

The following is default when the program starts with a new database:

```
SET DRAWING CHARACTER-TYPE SOFTWARE
SET DRAWING FONT-SIZE RELATIVE 1.0
SET DRAWING FONT-TYPE SIMPLE
SET DRAWING GRID ON
```

SET GRAPH

...	GRAPH	HISTOGRAM	...
		LINE-OPTIONS	...
		PIE-CHART	...
		XAXIS-ATTRIBUTES	...
		YAXIS-ATTRIBUTES	...
		ZAXIS-ATTRIBUTES	...

PURPOSE:

To set plot file characteristics.

PARAMETERS:

HISTOGRAM	Set options for display of a histogram.
LINE-OPTIONS	Set the options controlling how lines are drawn and marked.
PIE-CHART	Set options for display of a pie chart.
XAXIS-ATTRIBUTES	Set the options controlling the drawing and scale of the x-axis.
YAXIS-ATTRIBUTES	Set the options controlling the drawing and scale of the y-axis.
ZAXIS-ATTRIBUTES	Set the options controlling the drawing and scale of the z-axis.

NOTES:

All sub-commands and data are fully explained subsequently as each command is described in detail.

SET GRAPH HISTOGRAM

<table>
<tr><td rowspan="4">...</td><td rowspan="4">GRAPH HISTOGRAM</td><td>COLUMNS</td><td>ncol</td></tr>
<tr><td rowspan="3">FILLING</td><td>HATCHED</td></tr>
<tr><td>HOLLOW</td></tr>
<tr><td>SOLID</td></tr>
</table>

PURPOSE:

Set options controlling display of a histogram.

PARAMETERS:

COLUMNS	Set the number of columns in the histogram.
ncol	The number of columns in the histogram.
FILLING	The columns in the histogram can be filled with a HATCHED pattern, or not filled at all (HOLLOW), or be filled with a SOLID pattern.

NOTES:

1 To present a smooth histogram, the number of columns should be about 1/10 of the sample size or smaller.

2 When running the program on a black and white screen, it the it usually a good idea to change the default SOLID filling to a HOLLOW or HATCHED.

See also:

- DISPLAY RESULT DISTRIBUTION
- PLOT

EXAMPLES:

The following is default when the program starts with a new database:

```
SET GRAPH HISTOGRAM COLUMNS 20
SET GRAPH HISTOGRAM FILLING SOLID
```

SET GRAPH LINE-OPTIONS

<table>
<tr><td rowspan="5">...</td><td rowspan="5">GRAPH LINE-OPTIONS</td><td>LINE-TYPE</td><td>line</td><td>LINE-TYPE</td></tr>
<tr><td rowspan="2">MARKER</td><td colspan="2">ON</td></tr>
<tr><td colspan="2">OFF</td></tr>
<tr><td>MARKER-TYPE</td><td>line</td><td>MARKER-TYPE</td></tr>
<tr><td>MARKER-SIZE</td><td colspan="2">size</td></tr>
</table>

PURPOSE:

To set options controlling how lines are drawn and marked.

PARAMETERS:

LINE-TYPE	Controls how lines are drawn. Only six lines can be controlled.
line	A line number, from 1 to 6.
LINE-TYPE	The line type to use. One of: BLANK, END-POINT, DASHED, DASH-DOT, DEFAULT, DOTTED, SOLID.
MARKER	Turn usage of markers ON or OFF.
MARKER-TYPE	Control the marker type.
MARKER-TYPE	The type of marker to use. One of: CROSS, DEFAULT, DELTA, DIAMOND, NABLA, PLUS, SQUARE, STAR
MARKER-SIZE	Set the size of the markers.

NOTES:

Even when the MARKER option is ON, not all points on the curve need be marked. If more than 20 points are drawn and the line type is not BLANK, only a few points are marked in order to not clutter the curve with markers.

See also:

- DISPLAY
- PLOT

EXAMPLES:

The following is default when the program starts with a new database:

```
SET GRAPH LINE-OPTIONS LINE-TYPE DEFAULT    % for all lines
SET GRAPH LINE-OPTIONS MARKER ON
```

```
SET GRAPH LINE-OPTIONS MARKER-TYPE DEFAULT  % for all lines
SET GRAPH LINE-OPTIONS MARKER-SIZE 2.0
```

SET GRAPH PIE-CHART

<table>
<tr><td rowspan="13">...</td><td rowspan="13">GRAPH PIE-CHART</td><td rowspan="2">EXPLODED-SEGMENT</td><td colspan="2">OFF</td></tr>
<tr><td>SEGMENT-NAME</td><td>name</td></tr>
<tr><td rowspan="3">FILLING</td><td colspan="2">HATCHED</td></tr>
<tr><td colspan="2">HOLLOW</td></tr>
<tr><td colspan="2">SOLID</td></tr>
<tr><td rowspan="8">LABEL</td><td rowspan="2">VISIBILITY</td><td>HIDE</td></tr>
<tr><td>SHOW</td></tr>
<tr><td rowspan="2">ORIENTATION</td><td>HORIZONTAL</td></tr>
<tr><td>ROTATED</td></tr>
<tr><td rowspan="3">POSITION</td><td>OUTSIDE</td></tr>
<tr><td>AUROMATIC</td></tr>
<tr><td>INSIDE</td></tr>
<tr><td>VALUE</td><td>ON/OFF</td></tr>
</table>

PURPOSE:

Set options controlling display of a pie chart.

PARAMETERS:

EXPLODED-SEGMENT	Controls if a segment of the pie is to be shown exploded (i.e. detached from the rest).
OFF	No segment is to be exploded.
SEGMENT-NAME name	Explode the segment with the given name. No segment will be exploded if the name does not match any of the segment names in the pie to be displayed. The name can be abbreviated and the matching of names disregards the text case.
FILLING	The columns in the histogram can be filled with a HATCHED pattern, or not filled at all (HOLLOW), or be filled with a SOLID pattern.
LABEL	Define the drawing of the pie segment labels.
VISIBILITY	HIDE or SHOW the pie segment labels.
ORIENTATION	Draw the pie segment labels HORIZONTAL or ROTATED to follow the segment angle.

POSITION	Draw the pie segment labels OUTSIDE the pie, INSIDE the pie or use an AUTOMATIC placement, where they are drawn inside if possible.
VALUE ON/OFF	Show the value (size) of the pie segment (ON) or hide it (OFF).

NOTES:

When running the program on a black and white screen, it the it usually a good idea to change the default SOLID filling to a HOLLOW or HATCHED.

See also:

- DISPLAY RESULT IMPORTANCE-FACTORS
- PLOT

EXAMPLES:

The following is default when the program starts with a new database:

```
SET GRAPH PIE-CHART EXPLODED-SEGMENT OFF
SET GRAPH PIE-CHART FILLING SOLID
SET GRAPH PIE-CHART LABEL VISIBILITY SHOW
SET GRAPH PIE-CHART LABEL ORIENTATION HORIZONTAL
SET GRAPH PIE-CHART LABEL POSITION AUTOMATIC
SET GRAPH PIE-CHART LABEL VALUE ON
```

SET GRAPH XAXIS-ATTRIBUTES

<table>
<tr><td rowspan="10">...</td><td rowspan="10">GRAPH</td><td rowspan="10">XAXIS-ATTRIBUTES</td><td rowspan="4">DECIMAL-FORMAT</td><td colspan="2">EXPONENTIAL</td></tr>
<tr><td colspan="2">FIXED</td></tr>
<tr><td colspan="2">GENERAL</td></tr>
<tr><td colspan="2">INTEGER</td></tr>
<tr><td rowspan="2">LIMITS</td><td>FIXED</td><td>xmin, xmax</td></tr>
<tr><td colspan="2">FREE</td></tr>
<tr><td rowspan="2">SPACING</td><td colspan="2">LINEAR</td></tr>
<tr><td colspan="2">LOGARITHMIC</td></tr>
<tr><td rowspan="2">TITLE</td><td colspan="2">DEFAULT</td></tr>
<tr><td>SPECIFIED</td><td>xtitle</td></tr>
</table>

PURPOSE:

Control the drawing of the X axis in a graph display.

PARAMETERS:

DECIMAL-FORMAT	Controls the presentation of numbers labelling the x axis.
EXPONENTIAL	The numbers are presented in exponential format (e.g. 1.233E+01).
FIXED	The numbers are presented in fixed format (e.g. 12.33)
GENERAL	The numbers are presented in general (free) format.
INTEGER	The numbers are presented as integers.
LIMITS	Controls the limits of the x axis.
FREE	The limits are determined by the data that are being presented.
FIXED xmin xmax	The limits are fixed to the minimum value xmin and the maximum value xmax.
SPACING	Controls the spacing of numbers along the axis.
LINEAR	The axis has a LINEAR spacing.
LOGARITHMIC	The axis has a logarithmic spacing with base 10.
TITLE	Set the title at the x axis.

DEFAULT	The title is specified by Profast according to the current graphs being drawn.
SPECIFIED xtitle	The specified title text is used.

NOTES:

In some cases the settings provided here may be overridden, for example SN-curves are always displayed with a log-log spacing.

See also:

- DISPLAY
- PLOT
- SET GRAPH YAXIS-ATTRIBUTTES
- SET GRAPH ZAXIS-ATTRIBUTTES

EXAMPLES:

The following is default when the program starts with a new database:

```
SET GRAPH XAXIS-ATTRIBUTES DECIMAL-FORMAT GENERAL
SET GRAPH XAXIS-ATTRIBUTES LIMITS FREE
SET GRAPH XAXIS-ATTRIBUTES SPACING LINEAR
SET GRAPH XAXIS-ATTRIBUTES TITLE DEFAULT
```

SET GRAPH YAXIS-ATTRIBUTES

<table>
<tr><td rowspan="10">...</td><td rowspan="10">GRAPH</td><td rowspan="10">YAXIS-ATTRIBUTES</td><td rowspan="4">DECIMAL-FORMAT</td><td colspan="2">EXPONENTIAL</td></tr>
<tr><td colspan="2">FIXED</td></tr>
<tr><td colspan="2">GENERAL</td></tr>
<tr><td colspan="2">INTEGER</td></tr>
<tr><td rowspan="2">LIMITS</td><td>FIXED</td><td>ymin, ymax</td></tr>
<tr><td colspan="2">FREE</td></tr>
<tr><td rowspan="2">SPACING</td><td colspan="2">LINEAR</td></tr>
<tr><td colspan="2">LOGARITHMIC</td></tr>
<tr><td rowspan="2">TITLE</td><td colspan="2">DEFAULT</td></tr>
<tr><td>SPECIFIED</td><td>ytitle</td></tr>
</table>

PURPOSE:

Control the drawing of the Y axis in a graph display.

PARAMETERS:

DECIMAL-FORMAT	Controls the presentation of numbers labelling the y axis.
EXPONENTIAL	The numbers are presented in exponential format (e.g. 1.233E+01).
FIXED	The numbers are presented in fixed format (e.g. 12.33)
GENERAL	The numbers are presented in general (free) format.
INTEGER	The numbers are presented as integers.
LIMITS	Controls the limits of the y axis.
FREE	The limits are determined by the data that are being presented.
FIXED ymin ymax	The limits are fixed to the minimum value ymin and the maximum value ymax.
SPACING	Controls the spacing of numbers along the axis.
LINEAR	The axis has a LINEAR spacing.
LOGARITHMIC	The axis has a logarithmic spacing with base 10.
TITLE	Set the title at the y axis.

DEFAULT	The title is specified by Profast according to the current graphs being drawn.
SPECIFIED ytitle	The specified title text is used.

NOTES:

In some cases the settings provided here may be overridden, for example SN-curves are always displayed with a log-log spacing.

See also:

- DISPLAY
- PLOT
- SET GRAPH XAXIS-ATTRIBUTTES
- SET GRAPH ZAXIS-ATTRIBUTTES

EXAMPLES:

The following is default when the program starts with a new database:

```
SET GRAPH YAXIS-ATTRIBUTES DECIMAL-FORMAT GENERAL
SET GRAPH YAXIS-ATTRIBUTES LIMITS FREE
SET GRAPH YAXIS-ATTRIBUTES SPACING LINEAR
SET GRAPH YAXIS-ATTRIBUTES TITLE DEFAULT
```

SET GRAPH ZAXIS-ATTRIBUTES

<table>
<tr><td rowspan="10">...</td><td rowspan="10">GRAPH</td><td rowspan="10">ZAXIS-ATTRIBUTES</td><td rowspan="4">DECIMAL-FORMAT</td><td colspan="2">EXPONENTIAL</td></tr>
<tr><td colspan="2">FIXED</td></tr>
<tr><td colspan="2">GENERAL</td></tr>
<tr><td colspan="2">INTEGER</td></tr>
<tr><td rowspan="2">LIMITS</td><td>FIXED</td><td>zmin, zmax</td></tr>
<tr><td colspan="2">FREE</td></tr>
<tr><td rowspan="2">SPACING</td><td colspan="2">LINEAR</td></tr>
<tr><td colspan="2">LOGARITHMIC</td></tr>
<tr><td rowspan="2">TITLE</td><td colspan="2">DEFAULT</td></tr>
<tr><td>SPECIFIED</td><td>ztitle</td></tr>
</table>

PURPOSE:

Control the drawing of the Z axis in a graph display.

PARAMETERS:

DECIMAL-FORMAT	Controls the presentation of numbers labelling the z axis.
EXPONENTIAL	The numbers are presented in exponential format (e.g. 1.233E+01).
FIXED	The numbers are presented in fixed format (e.g. 12.33)
GENERAL	The numbers are presented in general (free) format.
INTEGER	The numbers are presented as integers.
LIMITS	Controls the limits of the z axis.
FREE	The limits are determined by the data that are being presented.
FIXED zmin zmax	The limits are fixed to the minimum value and the maximum value zmax.
SPACING	Controls the spacing of numbers along the axis.
LINEAR	The axis has a LINEAR spacing.
LOGARITHMIC	The axis has a logarithmic spacing with base 10.
TITLE	Set the title at the z axis.

DEFAULT	The title is specified by Profast according to the current graphs being drawn.
SPECIFIED ztitle	The specified title text is used.

NOTES:

In some cases the settings provided here may be overridden, for example SN-curves are always displayed with a log-log spacing.

See also:

- DISPLAY
- PLOT
- SET GRAPH XAXIS-ATTRIBUTTES
- SET GRAPH YAXIS-ATTRIBUTTES

EXAMPLES:

The following is default when the program starts with a new database:

```
SET GRAPH ZAXIS-ATTRIBUTES DECIMAL-FORMAT GENERAL
SET GRAPH ZAXIS-ATTRIBUTES LIMITS FREE
SET GRAPH ZAXIS-ATTRIBUTES SPACING LINEAR
SET GRAPH ZAXIS-ATTRIBUTES TITLE DEFAULT
```

SET PLOT

...	PLOT	COLOUR	ON
			OFF
		FORMAT	SESAM-NEUTRAL
			HPGL-2
			HPGL-7470
			HPGL-7550
			LN03-PLUS
			POSTSCRIPT
		FILE	prefix, name
		PAGE-SIZE	SIZE

PURPOSE:

To set plot file characteristics.

PARAMETERS:

COLOUR	Sets the output to the plot file to be in colours (ON) or monochrome (OFF).
FORMAT	Set the type of plot file to be used. Please note that the actual range of devices is machine dependent.
SESAM-NEUTRAL	SESAM Neutral format. This is the default format. It can be converted to other formats and/or manipulated by use if the utility program PLTCNV.
POSTSCRIPT	PostScript format (PostScript is a trademark of Adobe Systems Incorporated). Note that this requires access to a printer that accepts PostScript files.
HPGL-2	HP Laserjet printer.
HPGL-7550	HP 7550 plotter.
HPGL-7470	HP 7470 plotter.
LN03-PLUS	Digital LN03 Plus laser printer/plotter (or other device with Tektronix 4014 emulation).

FILE prefix name	Set the prefix and name of the plot file. The prefix and name are concatenated. The suffix of the file will depend on the format of the file.
PAGE-SIZE	Sets the size of the plot.
SIZE	One of: A1, A2, A3, A4 or A5.

NOTES:

1 When one of these settings is changed, a new plot file will be opened the next time a plot is written.

2 One plot file may contain more than one plot.

3 There is two ways of generating a plot:

By use of the PLOT command.

By use of SET DISPLAY DESTINATION FILE followed by a DISPLAY command.

See also:

- SET DISPLAY DESTINATION
- PLOT

EXAMPLES:

The following is default when the program starts with a new database:

```
SET PLOT COLOUR ON
SET PLOT FILE % same prefix and name as the database and journal file
SET PLOT FORMAT SESAM-NEUTRAL
SET PAGE-SIZE A4
```

SET PRINT

<table>
<tr><td rowspan="7">...</td><td rowspan="2">DESTINATION</td><td colspan="2">FILE</td></tr>
<tr><td colspan="2">SCREEN</td></tr>
<tr><td>FILE</td><td>prefix</td><td>name</td></tr>
<tr><td rowspan="2">PAGE-ORIENTATION</td><td colspan="2">LANDSCAPE</td></tr>
<tr><td colspan="2">PORTRAIT</td></tr>
<tr><td>SCREEN-HEIGHT</td><td colspan="2">nlines</td></tr>
</table>

PURPOSE:

To set print characteristics.

PARAMETERS:

DESTINATION	Set the destination of the printed output to the SCREEN or to a FILE.
FILE prefix name	Set the prefix and name of the print file. The prefix and name are concatenated. The suffix of the file will be .LIS.
PAGE-ORIENTATION	Set the page orientation for the print file. See note 2 below:
LANDSCAPE	The print page is 132 characters wide.
PORTRAIT	The print page is 80 characters wide.
SCREEN-HEIGHT nlines	Set number of lines in one screen page to nlines. The purpose of this is to be able to pause the printout at the correct time when printing to SCREEN in a line mode run.

NOTES:

1 The print DESTINATION is reset to SCREEN each time the program starts up, even if it is on an existing database.

2 The following figure illustrates the print layout:

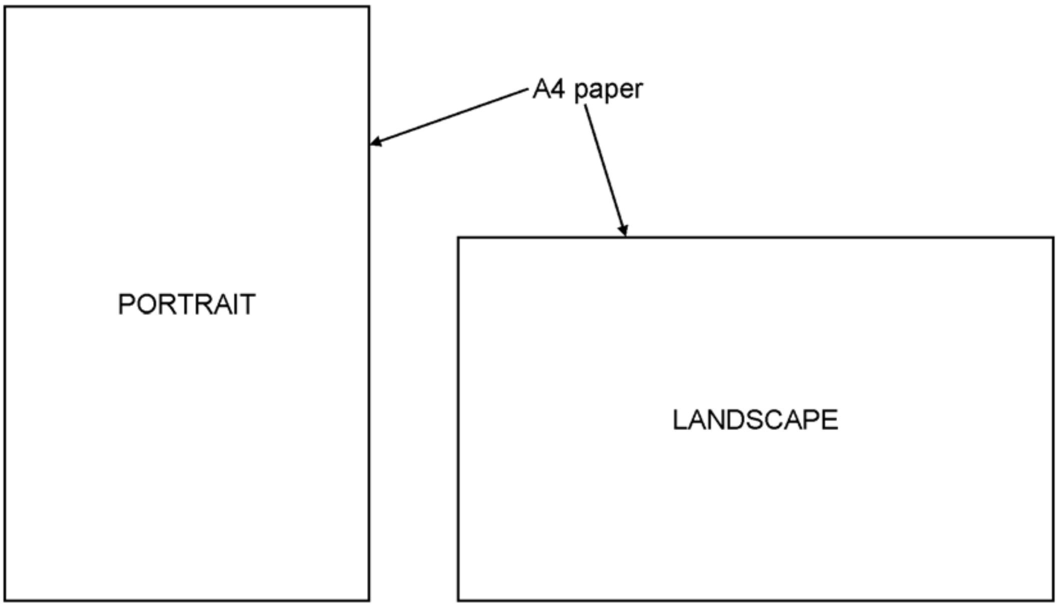


Figure 5.4 Setting PORTRAIT and LANDSCAPE print page orientation

See also:

- SET DISPLAY DESTINATION
- PLOT

EXAMPLES:

The following is default when the program starts with a new database:

```
SET PRINT DESTINATION SCREEN
SET PLOT FILE % same prefix and name as the database and journal file
SET PLOT PAGE-ORIENTATION LANDSCAPE
SET SCREEN-HEIGHT 24 % On VMS, Proban sets the correct height.
```

VIEW

VIEW	FRAME	...
	PAN	...
	POSITION	...
	ROTATE	...
	ZOOM	...

PURPOSE:

To control the appearance of the 3D view, by specification of view angles, zoom and pan.

PARAMETERS:

FRAME	Perform an automatic zoom to fit the current view within the frame of the display.
PAN	Pan (shift) the current view in the plane of the screen.
POSITION	Define the view angles by specifying a point in space which, together with the centre of the model's coordinate system, defines the direction of the user's observation.
ROTATE	Rotate view by specifying rotation angles.
ZOOM	Zoom in or out.

NOTES:

1 All sub-commands and data are fully explained subsequently as each command is described in detail.

2 This command is not journalled.

3 The VIEW command works differently in the graphics user interface. It is collected into one dialog, and is available through the Structure menu. The manipulations are performed by typing in the relevant numbers, then clicking on the buttons in the dialog box. See figure below.

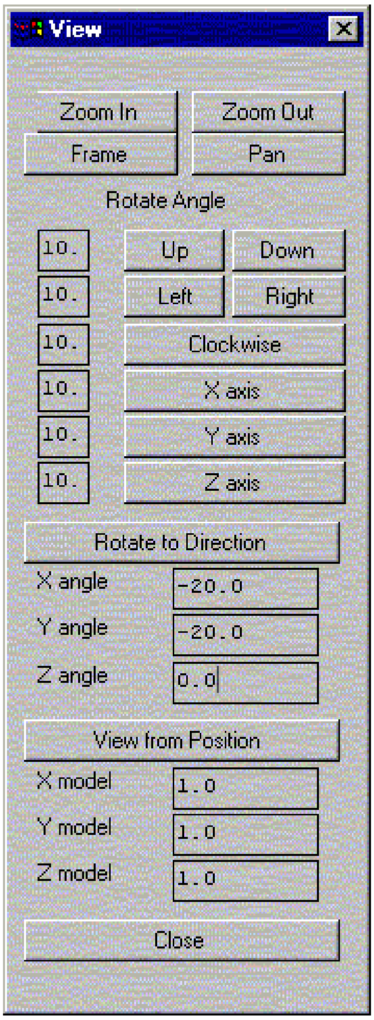


Figure 5.5 The graphics user interface View dialog

See also:

- DISPLAY MEMBER
- DISPLAY JOINT
- DISPLAY SUPERELEMENT

VIEW FRAME

...	FRAME

PURPOSE:

Perform an automatic zoom to fit the current view within the frame of the display.

PARAMETERS:

None:

NOTES:

This command is not journalled.

See also:

- DISPLAY MEMBER
- DISPLAY JOINT
- DISPLAY SUPERELEMENT

VIEW PAN

...	PAN	pick_from	pick_to

PURPOSE:

Pan (shift) the current view in the plane of the screen. The view is shifted by defining a vector in the plane of the screen. The vector is defined by picking the "from" and the "to" positions, see below.

PARAMETERS:

pick_from	Pick (using mouse or cross-hair) a point on the screen to define the "from" position.
pick_to	Pick (using mouse or cross-hair) a point on the screen to define the "to" position.

NOTES:

This command is not journalled.

See also:

- DISPLAY MEMBER
- DISPLAY JOINT
- DISPLAY SUPERELEMENT

VIEW POSITION

...	POSITION	x-model	y-model	z-model

PURPOSE:

Define the view angles by specifying a point in space. The imaginary line from this point towards the origin of the model's coordinate system defines the direction of the user's observation.

PARAMETERS:

x-model x-coordinate in the model's coordinate system.

y-model y-coordinate in the model's coordinate system.

z-model y-coordinate in the model's coordinate system.

NOTES:

1 This command is not journalled.

2 This command is independent of any previously entered rotations, and can therefore be used to "reset" the viewing direction.

See also:

- DISPLAY MEMBER
- DISPLAY JOINT
- DISPLAY SUPERELEMENT

VIEW ROTATE

...	ROTATE	TO	angle-x, angle-y, angle-z	(Screen mode)
		UP	angle-x-screen	
		DOWN	angle-x-screen	
		LEFT	angle-y-screen	
		RIGHT	angle-y-screen	
		CLOCKWISE	angle-z-screen	
		X-AXIS	angle-x-model	(Space mode)
		Y-AXIS	angle-y-model	
		Z-AXIS	angle-z-model	

PURPOSE:

Rotate view by specifying rotation angles. Note that this command operates in two basic modes, screen mode and space mode.

Screen mode (TO, UP, DOWN, LEFT, RIGHT & CLOCKWISE alternatives): Here, all angles are relative to the screen axes, which remains fixed, no matter how many rotations are entered. The angles should be interpreted such that it is the observer (the user) that revolves around a stationary model.

The origin of the screen axis system lies in the centre of the screen. The x-axis is horizontal and points from the origin towards the right hand side of the screen. The y-axis is vertical and points from the origin towards the top of the screen. The z-axis is horizontal and points from the origin and out of the screen (towards the user).

Space mode (X-AXIS, Y-AXIS & Z-AXIS alternatives). Here, all angles are relative to the model axes, which follow the rotations. The angles should be interpreted such that it is the model coordinate system that rotates relative to the observer.

PARAMETERS:

TO angle-x angle-y angle-z	This alternative is independent of all previously entered rotations. At the execution of this command, the program first re-initialises the rotations, such that the model and screen axes overlap. Then, the x, y and z rotations specified by the user are applied, in the same order.
UP angle-x-screen	Rotate the view position angle-x-screen degrees UP, relative to the screen x-axis, from the current position.
DOWN angle-x-screen	Rotate the view position angle-x-screen degrees DOWN, relative to the screen x-axis, from the current position.

LEFT angle-y-screen	Rotate the view position angle-y-screen degrees LEFT, relative to the screen y-axis, from the current position.
RIGHT angle-y-screen	Rotate the view position angle-y-screen degrees RIGHT, relative to the screen y-axis, from the current position.
CLOCKWISE angle-z-screen	Rotate the view position angle-z-screen degrees CLOCKWISE, relative to the screen z-axis, from the current position.
X-AXIS angle-x-model	Rotate the model coordinate system angle-x-model around the model x-axis.
Y-AXIS angle-y-model	Rotate the model coordinate system angle-x-model around the model y-axis.
Z-AXIS angle-z-model	Rotate the model coordinate system angle-x-model around the model z-axis.

NOTES:

This command is not journalled.

See also:

- DISPLAY MEMBER
- DISPLAY JOINT
- DISPLAY SUPERELEMENT

VIEW ZOOM

<table>
<tr><td rowspan="2">...</td><td rowspan="2">ZOOM</td><td>IN</td><td rowspan="2">pick</td><td rowspan="2">pick</td></tr>
<tr><td>OUT</td></tr>
</table>

PURPOSE:

To zoom the current view in or out.

PARAMETERS:

IN	Zoom out by pointing to two diagonal corners in a square on the screen. The part of the view within the square will then be enlarged and fitted within the whole screen, causing an illusion of movement towards the model.
OUT	Zoom out by pointing to two diagonal corners in a square on the screen. The current view will then be compressed and fitted within the smaller square, causing an illusion of movement away from the model.

NOTES:

This command is not journalled.

See also:

- DISPLAY MEMBER
- DISPLAY JOINT
- DISPLAY SUPERELEMENT

APPENDIX A TUTORIAL EXAMPLES

The tutorial is based on a relatively simple structure. The example is based on the model shown below.

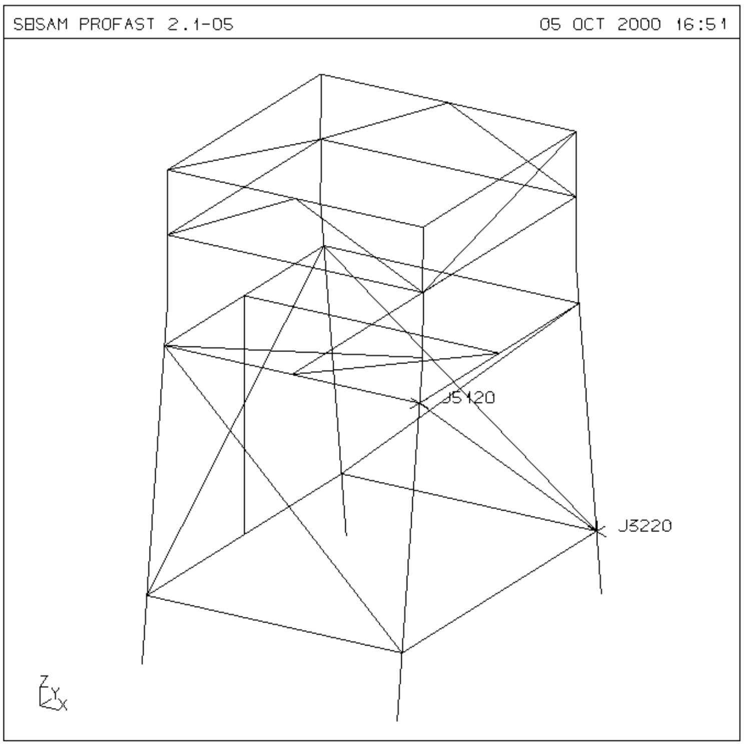


Figure A.1 The structure used in the tutorial with the critical points marked

Input to the example is a SESAM interface (SIN) file for the model, a command input file for Framework and a command input file for Profast. The Framework analysis produces a FRAMEWORK.MOD model file, which is then used by Profast.

This appendix contains the command input files and some results produced by the runs.

A 1 The Initial Framework Analysis

The purpose of this analysis is to identify the critical hotspots to be used in Profast by calculating the stochastic fatigue life for a selected number of joints.

A 1.1 Framework Command Input File

```
%============================================================================
%                  TUTORIAL FOR PROFAST USER'S MANUAL
%============================================================================
%
% Local and parametric SCFs are used.
%
% Only a subset of elements are checked
%
% Working units are Newtons and mm
%
% In this example no CAN or STUB sections are used. For all calculations
% nominal section properties are used.
%
%============================================================================
%
% Let us start by opening a Results Interface file called X108CR1.SIN
%
 FILE OPEN SIN X108C R1
%
% Where X108C.......... is the Results file prefix
%       R1............. is the Results file name
%
% Transfer superelement number 1
%
 FILE TRANSFER 1 JACKET WAVE_LOADS 'loads for stochastic fatigue'
%
% Where 1.............. is the key identifying the superelement read
%       JACKET........  is the name given to the superelement
%       WAVE_LOADS..... is the loadset name
%
% Youngs modulus is now read from the Results Interface File and does
% not need to be assigned. Its value is 200000 N/mm**2
%
% Assign environmental data
%
% Create scatter diagram
%
 CREATE WAVE-STATISTICS SCATTER 'ARBITRARY DATA'
```

```
     SCATTER-DIAGRAM PROBABILITY
     (
%%%    Hs      Tz      Prob
      1750.0  4.75   0.249
      1750.0  7.75   0.086
      1250.0  6.25   0.236
      3250.0  6.25   0.206
      4750.0  7.75   0.117
      4750.0  7.75   0.106
     )
%
% Create a wave spreading function
%
 CREATE WAVE-SPREADING-FUNCTION DIS2 'DISCRETE COS**2' USER-DEFINED
     (
%%  Dir  Weigth
     -45  0.25
       0  0.50
      45  0.25
     )
%
% Assign the wave spreading function.
%
 ASSIGN WAVE-SPREADING-FUNCTION SCATTER DIS2 ALL
%
% Assign a Pierson-Moskowitz spectrum for all seastates.
%
 ASSIGN WAVE-SPECTRUM-SHAPE SCATTER PIERSON-MOSKOWITZ ALL
%
% Assign scatter diagrams for each of the main wave directions.
%
 ASSIGN WAVE-STATISTICS
   LOOP
%%%   Dir   Name
      -45   SCATTER
        0   SCATTER
       45   SCATTER
       90   SCATTER
      135   SCATTER
   END
%
% Assign the probability of ocurrence for each of the main wave directions.
%
 ASSIGN WAVE-DIRECTION-PROBABILITY
   LOOP
%%%   Dir   Prob
      -45   0.0
        0   0.9
       45   0.0
       90   0.1
      135   0.0
   END
```

```
%
% Create a modified SN-curve. This is necessary because the units in
% the model are in N/mm2 and because the E modulus is different from
% 2.0E5 N/m2 (if the E modulus had been 2.1E5 N/m2 the predefined
% DNV-X curve could have been used because Framework and Profast is
% then able to scale it to the correct units).
%
 CREATE SN-CURVE DNVX USER 'DNV-X curve in N/mm2'
                      4.1 34.0 8.301 HORISONTAL-TAIL
%
% Assign SN-CURVE for element 33115
%
 ASSIGN SN-CURVE JOINT 33115 CONNECTED-TO-MEMBER 33115 DNVX
%
% Assign LOCAL SCF's for elements 33115
%
 ASSIGN SCF JOINT 33115 ONLY 3110 ' ' LOCAL BOTH-SIDES
     NON-SYMMETRIC
%%% Hot Ax   Ipb  Opb
   ( 1  1.00 0.00 1.00
     4  0.00 0.00 0.00
     7  1.00 1.00 0.00
    10  0.00 0.00 0.00
    13  1.00 0.00 1.00
    16  0.00 0.00 0.00
    19  1.00 1.00 0.00
    22  0.00 0.00 0.00 )
%
 ASSIGN SCF JOINT 33115 ONLY 3120 ' ' LOCAL BOTH-SIDES
     NON-SYMMETRIC
%%% Hot Ax   Ipb  Opb
   ( 1  1.00 0.00 1.00
     4  0.00 0.00 0.00
     7  1.00 1.00 0.00
    10  0.00 0.00 0.00
    13  1.00 0.00 1.00
    16  0.00 0.00 0.00
    19  1.00 1.00 0.00
    22  0.00 0.00 0.00 )
%
% Assign SN-CURVE and SCFs for element 33215
%
 ASSIGN SN-CURVE JOINT 33215 CONNECTED-TO-MEMBER 33215 DNVX
 ASSIGN SCF JOINT 33215 CONNECTED-TO-MEMBER 33215 None PARAMETRIC WORDSWORTH
 ASSIGN JOINT-TYPE 33215 CONNECTED-TO-MEMBER 33215 X
%
% Assign SN-CURVE and SCFs for element 33415
%
 ASSIGN SN-CURVE JOINT 33415 CONNECTED-TO-MEMBER 33415 DNVX
 ASSIGN SCF JOINT 33415 CONNECTED-TO-MEMBER 33415 None PARAMETRIC KUANG
 ASSIGN JOINT-TYPE 33415 CONNECTED-TO-MEMBER 33415 KTT
 ASSIGN JOINT-GAP 33415 CONNECTED-TO-MEMBER 33415 1.
```

```
%
% Assign SN-CURVE and SCFs for element 35415
%
 ASSIGN SN-CURVE JOINT 35415 CONNECTED-TO-MEMBER 35415 DNVX
 ASSIGN SCF JOINT 35415 CONNECTED-TO-MEMBER 35415 None PARAMETRIC KUANG
 ASSIGN JOINT-TYPE 35415 CONNECTED-TO-MEMBER 35415 KTK
 ASSIGN JOINT-GAP 35415 CONNECTED-TO-MEMBER 35415 1.
%
% Define the target fatigue life
%
 DEFINE FATIGUE-CONSTANTS TARGET-FATIGUE-LIFE 20.0
%
% Perform fatigue check
%
 RUN FATIGUE-CHECK STOFAT 'STOCHASTIC FATIGUE ANALYSIS' ALL
    ( ONLY 33115 33215 33415 35415 )
%
% Print the results
%
 SET PRINT DESTINATION FILE
 SET PRINT FILE X108C STOFAT
 SET PRINT PAGE-ORIENTATION LANDSCAPE
%
 PRINT FATIGUE-CHECK-RESULTS STOFAT
     SELECTED-MEMBERS CURRENT FULL ABOVE 0.0
%
% Make the critical joints displayable in Profast
%
 SELECT SET JOINT CRITICAL ( ONLY 3220 5120 )
%
% End of fatigue checks.
%
%= THE END ==============================================================
```

A 1.2 Print File from Framework Analysis

```
                  ******       ******       ******       ******      ** ***  ****
                 ********     ********     ********     ********     *************
                **      **   **      **   **      **   **      **    **    **    **
                **           **      **   **                   **    **    **    **
                 *******     **********    *******      *********    **    **    **
                  *******    *********      *******    **********    **    **    **
                        **   **                   **   **      **    **    **    **
                **      **   **      **   **      **   **      **    **    **    **
                 ********     ********     ********     *********    **    **    **
                  ******       ******       ******       ****** **   **    **    **



   *********************************************************************************************
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   **     *******  ******    *****   *     *  *******  *     *   *****   ******   *    *      **
   **     *        *     *  *     *  **   **  *        *     *  *     *  *     *  *   *       **
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   **     *****    ******   *******  *  *  *  *****    *  *  *  *     *  ******   ***         **
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   **                                                                                         **
   **                                                                                         **
   **                          Postprocessing of Frame Structures                             **
   **                                                                                         **
   **                                                                                         **
   *********************************************************************************************
   *********************************************************************************************


                                Marketing and Support by DNV Sesam



Program id   : M2.1-05                                          Computer         : DEC 3000 - M300LX
Release date : 11-JAN-1996                                      Impl. update     :
```

Access time : 11-JAN-1996 08:44:22
User id : OLES

Operating system : VMS V6.1
CPU id : 0992692168
Installation : DNVS SIV

STOCHASTIC fatigue check results
Run: Superelement: Loadset:
STOFAT JACKET WAVE_LOADS
Priority....: Selected Members
Usage factor: Above 0.00 SUB PAGE: 1

NOMENCLATURE:

Member	Name of member
Type	Section type
Joint/Po	Joint name or position within the member
Outcome	Outcome message from the code check
Damage	Accumulated damage
Life	Fatigue life
WeldSide	Side of weld
Hot	Hotspot (stress point) with maximum damage
SCFrule	Method used for SCF calculation
SCFax	SCF for axial force
SCFipb	SCF for in plane bending
SCFopb	SCF for out of plane bending
SNcurve	SN curve name
SctNam	Section name
Alpha	Moment transformation angle from local to in/out-of-plane co. system
Symmet	Symmetry in SCF specifiation
DiaBra	Brace diameter
ThiBra	Brace thickness
Gap	Gap between braces

ThiFac Thickness correction factor on SN-curve
QR Marchall reduction factor applied on SCFs
Cycles Total number of stress cycles
Theta Angle between brace and chord in degrees
Jtype Joint type
DiaCho Chord diameter
ThiCho Chord thickness
LenCho Chord length
FixCho Chord end fixity parameter
SCFaxC SCF for axial force at Crown (Hotspot 7)

SCFaxS SCF for axial force at Saddle (Hotspot 1)

DATE: 11-JAN-1996 TIME: 08:44:22 PROGRAM: SESAM FRAMEWORK M2.1-05 11-JAN-1996 PAGE: 2

STOCHASTIC fatigue check results
Run: Superelement: Loadset:
STOFAT JACKET WAVE_LOADS
Priority....: Selected Members
Usage factor: Above 0.00 SUB PAGE: 2

Member	Type	Joint/Po	Outcome	Damage	Life	WeldSide	Hot	SCFrule	SCFax	SCFipb	SCFopb	SNcurve
	SctNam				Alpha	Symmet	DiaBra	ThiBra	Gap	ThiFac	QR	Cycles
					Theta	Jtype	DiaCho	ThiCho	LenCho	FixCho	SCFaxC	SCFaxS
33115	PIPE	3110		1.12E-04	1.78E+05	BOTH-SIDE	19	LOCAL	1.000	1.000	0.000	DNVX
	50025				7.125	NON-SYMME	5.00E+02	2.50E+01	0.00E+00	1.000	1.000	9.21E+07
					90.000	YT	1.60E+03	6.00E+01	3.63E+04	1.000	1.000	1.000
		3120		1.86E-04	1.07E+05	BOTH-SIDE	7	LOCAL	1.000	1.000	0.000	DNVX
					7.125	NON-SYMME	5.00E+02	2.50E+01	0.00E+00	1.000	1.000	9.18E+07
					90.000	YT	1.60E+03	6.00E+01	3.63E+04	1.000	1.000	1.000
33215	PIPE	3210		1.51E-01	1.33E+02	CHORD-SID	22	WORDSWORT	5.991	2.500	2.602	DNVX
	50025				352.875	CROWN-SAD	5.00E+02	2.50E+01	0.00E+00	1.000	1.000	8.47E+07
					90.000	YT	1.60E+03	6.00E+01	3.63E+04	1.000	5.991	5.991
		3210		1.97E-01	1.01E+02	BRACE-SID	22	WORDSWORT	8.081	2.500	2.909	DNVX
					352.875	CROWN-SAD	5.00E+02	2.50E+01	0.00E+00	1.000	0.800	8.45E+07
					90.000	YT	1.60E+03	6.00E+01	3.63E+04	1.000	8.081	8.081
		3220		1.80E-01	1.11E+02	BRACE-SID	10	WORDSWORT	8.081	2.500	2.909	DNVX
					352.875	CROWN-SAD	5.00E+02	2.50E+01	0.00E+00	1.000	0.800	8.41E+07

					90.000	YT	1.60E+03	6.00E+01	3.63E+04	1.000	8.081	8.081
		3220		1.34E-01	1.49E+02	CHORD-SID	10	WORDSWORT	5.991	2.500	2.602	DNVX
					352.875	CROWN-SAD	5.00E+02	2.50E+01	0.00E+00	1.000	1.000	8.44E+07
					90.000	YT	1.60E+03	6.00E+01	3.63E+04	1.000	5.991	5.991
33415	PIPE	3220		6.06E-02	3.30E+02	CHORD-SID	10	KUANG	2.500	2.500	2.571	DNVX
	50025				0.000	CROWN-SAD	5.00E+02	2.50E+01	1.00E+00	1.000	1.000	8.17E+07
					82.875	K	1.60E+03	6.00E+01	3.63E+04	1.000	2.500	2.500
		3220		1.09E-01	1.83E+02	BRACE-SID	10	KUANG	3.182	2.692	2.866	DNVX
					0.000	CROWN-SAD	5.00E+02	2.50E+01	1.00E+00	1.000	0.800	8.21E+07
					82.875	K	1.60E+03	6.00E+01	3.63E+04	1.000	3.182	3.182
		3120		3.43E-01	5.82E+01	BRACE-SID	22	KUANG	7.964	2.500	2.866	DNVX
					0.000	CROWN-SAD	5.00E+02	2.50E+01	0.00E+00	1.000	0.800	8.73E+07
					82.875	YT	1.60E+03	6.00E+01	3.63E+04	1.000	7.964	7.964
		3120		1.70E-01	1.17E+02	CHORD-SID	22	KUANG	5.913	2.500	2.571	DNVX
					0.000	CROWN-SAD	5.00E+02	2.50E+01	0.00E+00	1.000	1.000	8.63E+07
					82.875	YT	1.60E+03	6.00E+01	3.63E+04	1.000	5.913	5.913
35415	PIPE	3220		3.65E-01	5.47E+01	CHORD-SID	10	KUANG	2.500	2.500	2.500	DNVX
	70020				0.000	CROWN-SAD	7.00E+02	2.00E+01	1.00E+00	1.000	1.000	8.06E+07
					44.468	K	1.60E+03	6.00E+01	3.63E+04	1.000	2.500	2.500
		3220		3.65E-01	5.47E+01	BRACE-SID	10	KUANG	2.500	2.500	2.500	DNVX
					0.000	CROWN-SAD	7.00E+02	2.00E+01	1.00E+00	1.000	0.800	8.06E+07
					44.468	K	1.60E+03	6.00E+01	3.63E+04	1.000	2.500	2.500
		5120	**Fail**	1.76E+00	1.14E+01	BRACE-SID	10	KUANG	2.500	2.500	2.500	DNVX
					0.000	CROWN-SAD	7.00E+02	2.00E+01	1.00E+00	1.000	0.800	8.65E+07
					58.718	K	1.60E+03	6.00E+01	3.93E+04	1.000	2.500	2.500
		5120	**Fail**	1.76E+00	1.14E+01	CHORD-SID	10	KUANG	2.500	2.500	2.500	DNVX
					0.000	CROWN-SAD	7.00E+02	2.00E+01	1.00E+00	1.000	1.000	8.65E+07
					58.718	K	1.60E+03	6.00E+01	3.93E+04	1.000	2.500	2.500

A 1.3 The Profast Analysis

The command input file is presented here in full.

The print file becomes too large, and it is therefore not presented here. Examples of printed output can be found in chapter 3 and with the PRINT command descriptions in chapter 5.

Similarly, the plots written by execution of this command input file are not presented in this appendix. Several of these plots can be found in chapter 2 and 3.

A 1.3.1 Profast Command Input File

```
%===========================================================================
%                   TUTORIAL FOR PROFAST USER'S MANUAL
%=======================================================
% The default stress range assignment is Sum-Rayleigh.
% Check the deterministic life time with the FRAMEWORK results.
%
RUN SN-ANALYSIS LIFE-TIME J5120 DETERMINISTIC
RUN SN-ANALYSIS LIFE-TIME J3220 DETERMINISTIC
%
% What would happen to the deterministic fatigue life if a fit
% was made to the scatter distribution?
%
ASSIGN WAVE-SCATTER-DISTRIBUTION SCATTER LOGNORMAL
RUN SN-ANALYSIS LIFE-TIME J3220 DETERMINISTIC
RUN SN-ANALYSIS LIFE-TIME J5120 DETERMINISTIC
ASSIGN WAVE-SCATTER-DISTRIBUTION SCATTER FANG-HOGBEN
RUN SN-ANALYSIS LIFE-TIME J3220 DETERMINISTIC
RUN SN-ANALYSIS LIFE-TIME J5120 DETERMINISTIC
% Reset:
ASSIGN WAVE-SCATTER-DISTRIBUTION SCATTER NONE
%
% Now apply some uncertainties, in addition to the uncertainty
% on log(K) that has been defined already:
%
ASSIGN UNCERTAINTY VALUE ( ONLY J3220-m0 ) LOW
ASSIGN UNCERTAINTY VALUE ( ONLY J3220-lN0 ) MEDIUM
ASSIGN UNCERTAINTY VALUE ( ONLY J3220-ISCF ) MEDIUM
ASSIGN UNCERTAINTY VALUE ( ONLY J3220-OSCF ) MEDIUM
ASSIGN UNCERTAINTY VALUE ( ONLY J3220-ASCF ) MEDIUM
ASSIGN UNCERTAINTY VALUE ( ONLY J3220-MinerS ) HIGH
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-m0 ) LOW
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-lN0 ) MEDIUM
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-ASCF ) MEDIUM
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-OSCF ) MEDIUM
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-ISCF ) MEDIUM
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-MinerS ) HIGH
%
% Verification of the uncertainty application:
%
```

```
PRINT UNCERTAINTY VALUE *
%
% Find the distribution of the fatigue life. The deterministic fatigue
% life should be in the lower tail of this distribution, because it
% incorporates a safety factor (on log(K) of the SN curve).
%
% The upper tail of the distribution is quite large, thus the use of
% a logarithmic x axis on the graph of the distribution.
%
RUN SN-ANALYSIS LIFE-TIME J5120 PROBABILISTIC
RUN SN-ANALYSIS LIFE-TIME J3220 PROBABILISTIC
SET GRAPH XAXIS-ATTRIBUTES SPACING LOGARITHMIC
SET TITLE 'Deterministic lifetime is 11.1 years' ' ' ' ' ' '
DISPLAY SN-ANALYSIS LIFE-TIME J5120 DISTRIBUTION
SET PLOT FILE J5120 SNLIFE
PLOT
SET TITLE 'Deterministic lifetime is 55.4 years' ' ' ' ' ' '
DISPLAY SN-ANALYSIS LIFE-TIME J3220 DISTRIBUTION
SET PLOT FILE J3220 SNLIFE
PLOT
SET GRAPH XAXIS-ATTRIBUTES SPACING LINEAR
%
PRINT SN-ANALYSIS LIFE-TIME J3220
%
% The SN failure probability (and reliability index) may also be
% calculated. By default, it is calculated at 10 time points through
% the service life.
%
RUN SN-ANALYSIS FAILURE-PROBABILITY J5120
RUN SN-ANALYSIS FAILURE-PROBABILITY J3220
SET TITLE 'Sum-Rayleigh long term stress range' ' ' ' ' ' '
DISPLAY SN-ANALYSIS FAILURE-PROBABILITY J5120 RELIABILITY-INDEX
SET PLOT FILE J5120 SNFAIL
PLOT
DISPLAY SN-ANALYSIS FAILURE-PROBABILITY J3220 RELIABILITY-INDEX
SET PLOT FILE J3220 SNFAIL
PLOT
SET TITLE ' ' ' ' ' ' ' '
%
% The events J3220-SNFail and J5120-SNFail were created by PROFAST
% when running the SN failure analyses above. By doing a probability
% analysis of these events, the failure probability at the end of the
% service life is calculated, and importance factors may be examined.
%
RUN PROBABILITY-ANALYSIS J3220-SNFail
DISPLAY RESULT IMPORTANCE-FACTORS
%
RUN PROBABILITY-ANALYSIS J5120-SNFail
DISPLAY RESULT IMPORTANCE-FACTORS
%
% Now change the stress range definition to a Weibull distribution,
% fitted to the Sum-Rayleigh distribution that has been used up till
```

```
% now. The Sum-Rayleigh distribution cannot be used directly for a
% crack growth analysis.
%
% Three different fit options are used here and plotted, for comparison.
%
ASSIGN STRESS-RANGE J3220 WEIBULL-FIT FRACTILE-95-99
SET GRAPH YAXIS-ATTRIBUTES SPACING LOG
DISPLAY STRESS-RANGE J3220
SET PLOT FILE J3220 WBLF99
PLOT
ASSIGN STRESS-RANGE J3220 WEIBULL-FIT DETERMINISTIC
DISPLAY STRESS-RANGE J3220
SET PLOT FILE J3220 WBLDET
PLOT
ASSIGN STRESS-RANGE J3220 WEIBULL-FIT PROBABILISTIC
DISPLAY STRESS-RANGE J3220
SET PLOT FILE J3220 WBLPRO
PLOT
SET GRAPH YAXIS-ATTRIBUTES SPACING LINEAR
%
% The probabilistic fir is to be used in the following.
%
ASSIGN STRESS-RANGE J5120 WEIBULL-FIT PROBABILISTIC
%
% Recalculate the deterministic SN fatigue life time for comparison.
%
RUN SN-ANALYSIS LIFE-TIME J3220 DETERMINISTIC
RUN SN-ANALYSIS LIFE-TIME J5120 DETERMINISTIC
%
PRINT SN-ANALYSIS LIFE-TIME J3220
%
% The number of load cycles per second (Nu0) is calculated by PROFAST
% during the Weibull fit process. It will be treated as an uncertain
% parameter here:
%
ASSIGN UNCERTAINTY VALUE ( ONLY J3220-Nu0 ) MEDIUM
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-Nu0 ) MEDIUM
%
% Now recalculate the SN failure probability as a function of time:
%
RUN SN-ANALYSIS FAILURE-PROBABILITY J3220
PRINT SN-ANALYSIS FAILURE-PROBABILITY J3220
RUN SN-ANALYSIS FAILURE-PROBABILITY J5120
PRINT SN-ANALYSIS FAILURE-PROBABILITY J3220
%
% An initial crack growth model is assigned. The one dimensional
% tube surface geometry function is used with no weld magnification
% factor (this is the default).
%
ASSIGN CRACK-GROWTH-MODEL J3220 0 PARIS-1DIM 3.5 -31 NO-THRESHOLD
ASSIGN CRACK-GROWTH-MODEL J5120 0 PARIS-1DIM 3.5 -31 NO-THRESHOLD
ASSIGN GEOMETRY-FUNCTION J5120 TUBE-SURFACE DEPTH 0.1 20.0 0.1 .2
```

```
ASSIGN GEOMETRY-FUNCTION J3220 TUBE-SURFACE DEPTH 0.1 20.0 0.1 .2
%
% Uncertainty is applied to some of the crack growth model parameters.
%
ASSIGN UNCERTAINTY VALUE ( ONLY J3220-lnC ) STDV .77
ASSIGN UNCERTAINTY VALUE ( ONLY J3220-GFactor ) COV .1
ASSIGN UNCERTAINTY VALUE ( ONLY J3220-acRatio ) COV .1
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-lnC ) STDV .77
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-GFactor ) COV .1
ASSIGN UNCERTAINTY VALUE ( ONLY J5120-acRatio ) COV .1
%
PRINT UNCERTAINTY VALUE *
PRINT VARIABLE ( J3220-lnC J3220-m )
%
% Calculate and plot the crack growth failure probability as a
% function of time.
%
% Plot the SN reliability curve with the crack growth reliability curve
DEFINE PRESENTATION CRACK-GROWTH-ANALYSIS SN-FAILURE-CURVE ON
%
RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220
RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120
%
SET TITLE 'Before Calibration' ' ' ' ' ' '
PRINT CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220
PRINT CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120
DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220 RELIABILITY-INDEX
SET PLOT FILE J3220 CGF_BEF
PLOT
DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120 RELIABILITY-INDEX
SET PLOT FILE J5120 CGF_BEF
PLOT
SET TITLE ' ' ' ' ' ' ' '
%
% In order to make the crack growth result conform to the SN result,
% a calibration of the crack growth model parameters is made. In this
% case one parameter (the geometry function factor) and three time
% points is used.
%
DEFINE CALIBRATION-CRACK-GROWTH TIME-POINTS ( ONLY 2000.5 2010.5 2030.5 )
%
RUN CALIBRATION-CRACK-GROWTH J3220 ( ONLY J3220-GFacto-Mean )
DISPLAY CALIBRATION-CRACK-GROWTH J3220 FINAL
DISPLAY CALIBRATION-CRACK-GROWTH J3220 START-AND-FINAL
DISPLAY CALIBRATION-CRACK-GROWTH J3220 ALL-ITERATIONS
SET PLOT FILE J3220 CALIBR
PLOT
PRINT CALIBRATION-CRACK-GROWTH J3220
%
RUN CALIBRATION-CRACK-GROWTH J5120 ( ONLY J5120-GFacto-Mean )
DISPLAY CALIBRATION-CRACK-GROWTH J5120 ALL-ITERATIONS
DISPLAY CALIBRATION-CRACK-GROWTH J5120 START-AND-FINAL
```

```
DISPLAY CALIBRATION-CRACK-GROWTH J5120 ALL-ITERATIONS
SET PLOT FILE J5120 CALIBR
PLOT
%
% Recalculate the crack growth failure probability after calibration.
%
% This time importance factors are also calculated. By default they
% are turned off in this type of analysis in order to save computation
% time.
DEFINE CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY IMPORTANCE ON
%
SET TITLE 'After Calibration' ' ' ' ' ' ' '
RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220
PRINT CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220
DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220 RELIABILITY-INDEX
SET PLOT FILE J3220 CGF_CAL
PLOT
PRINT RESULT PARAMETER-STUDY IMPORTANCE *
%
% The importance factors are displayed as a function of time, and
% for three selected time points
%
DISPLAY RESULT PARAMETER-STUDY IMPORTANCE *
SET PLOT FILE J3220 CGF_IMPGRA
PLOT
SET DRAWING FONT-SIZE RELATIVE 1.3
DISPLAY RESULT IMPORTANCE ( 1990.8 2005.2 2020.5 )
SET PLOT FILE J3220 CGF_IMPPIE
PLOT
SET DRAWING FONT-SIZE RELATIVE 1.5
%
% Reset:
DEFINE CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY IMPORTANCE OFF
%
RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120
PRINT CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120
DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120 RELIABILITY-INDEX
SET PLOT FILE J5120 CGF_CAL
PLOT
%
SET TITLE ' ' ' ' ' ' ' ' '
%
% Do not clutter the coming crack growth failure curves with the
% SN failure curve:
%
DEFINE PRESENTATION CRACK-GROWTH-ANALYSIS SN-FAILURE OFF
%
% An inspection plan is to be made. The target reliability at the two
% points are different, but the same inspection quality is used.
%
ASSIGN TARGET-RELIABILITY J3220 3.5
ASSIGN TARGET-RELIABILITY J5120 3.0
```

```
ASSIGN INSPECTION-QUALITY ( ONLY J3220 J5120 ) LENGTH PODL-MPI-UW
%
% First, an optimised plan is constructed.
RUN PLAN-INSPECTION ( ONLY J3220 J5120 ) 1990.5 OPT 'Optimised plan'
%
% and printed:
PRINT PLAN-INSPECTION OPT CHRONOLOGICAL
PRINT PLAN-INSPECTION OPT POINTWISE
%
% Then, to show the difference in the messages displayed, the same
% plan is calculated with different options:
DEFINE PLAN-INSPECTION MONITOR-CALCULATION ON
DEFINE PLAN-INSPECTION KEEP-INSPECTIONS ON
DELETE PLAN-INSPECTION OPT
RUN PLAN-INSPECTION ( ONLY J3220 J5120 ) 1990.5 OPT 'Optimised plan'
%
% Since the inspections were kept, a crack growth analysis can be
% performed using the planned inspections:
%
SET TITLE 'Optimised Inspection Plan' ' ' ' ' ' ' '
RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220
PRINT CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220
DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220 RELIABILITY-INDEX
SET PLOT FILE J3220 CGF_OPT
PLOT
%
RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120
PRINT CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120
DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120 RELIABILITY-INDEX
SET PLOT FILE J5120 CGF_OPT
PLOT
%
SET TITLE ' ' ' ' ' ' ' '
% Need to delete the plan before another can be made.
DELETE PLAN-INSPECTION OPT
%
% Now, do another plan with prescribed inspection times at four
% year intervals, using the same procedure as above.
%
DEFINE PLAN-INSPECTION METHOD PRESCRIBED ( GROUP 1994.5 2018.5 4 2020.5 )
DEFINE PLAN-INSPECTION MONITOR-CALCULATION OFF
DEFINE PLAN-INSPECTION KEEP-INSPECTIONS OFF
RUN PLAN-INSPECTION ( ONLY J3220 J5120 ) 1990.5 PRE
                                         'Inspection every fourth year'
%
PRINT PLAN-INSPECTION PRE CHRONOLOGICAL
PRINT PLAN-INSPECTION PRE POINTWISE
%
DEFINE PLAN-INSPECTION MONITOR-CALCULATION ON
DEFINE PLAN-INSPECTION KEEP-INSPECTIONS ON
DELETE PLAN-INSPECTION PRE
RUN PLAN-INSPECTION ( ONLY J3220 J5120 ) 1990.5 PRE
```

```
                                         'Inspection every fourth year'
%
SET TITLE 'Prescribed Inspections, every fourth year' ' ' ' ' ' '
RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220
DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J3220 RELIABILITY-INDEX
SET PLOT FILE J3220 CGF_PRE
PLOT
%
RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120
DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120 RELIABILITY-INDEX
SET PLOT FILE J5120 CGF_PRE
PLOT
%
% Cleanup:
DELETE PLAN *
%
% Add an inspection at Joint 5120 after 4 years.
% The length was inspected, and a crack was found with length 5mm.
%
CREATE INSPECTION J5-I1 'First inspection at J5120' J5120 1994.5
                        NOT-OBSERVED CRACK-FOUND EQUAL-TO 5
%
% The observation is uncertain. The distribution is assumed to be
% Normal instead of the default Exponential distribution.
%
DEFINE UNCERTAINTY Inspection-Length Normal NONE
                                     NOT-USED NOT-USED NOT-USED .01 .05 .1
ASSIGN UNCERTAINTY VALUE J5-I1-Length STDV 0.2
%
% Print the inspection input:
PRINT INSPECTION J5-I1
%
% Calculate the crack growth failure reliability as a function of
% time during the service life, taking the observed crack into account:
%
RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120
SET TITLE 'Crack found, Length 5mm' ' ' ' ' ' '
SET DRAWING FONT-SIZE RELATIVE 1.5
DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120 RELIABILITY-INDEX
SET PLOT FILE J5120 CRACK
PLOT
%
% Now examine the effect of grinding the found crack away.
% The grind depth is assumed Normal distributed with a mean of
% 2mm and a standard deviation of 0.2mm.
%
ASSIGN REPAIR J5-I1 GRIND 2
%
DEFINE UNCERTAINTY Inspection-Grind Normal NONE
                                     NOT-USED NOT-USED NOT-USED .01 .05 .1
ASSIGN UNCERTAINTY VALUE J5-I1-Grind STDV 0.2
%
```

```
RUN CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120
SET TITLE 'Crack found, Grind depth 2mm' ' ' ' ' ' ' '
DISPLAY CRACK-GROWTH-ANALYSIS FAILURE-PROBABILITY J5120 RELIABILITY-INDEX
SET PLOT FILE J5120 GRIND
PLOT
%
%= THE END ================================================================
```

APPENDIX B VARIABLES AND EVENTS MAINTAINED BY PROFAST

This appendix contains a list of all variables and events created and maintained by PROFAST. All these variables and events are write protected, i.e. they cannot be deleted or changed directly by the user. They may only be affected indirectly through another action, e.g. changing an uncertainty.

Most of the variables and events are attached to a fatigue point, inspection or scatter diagram. In such a case the name of the variable is derived from the name of the parent object (e.g. NAME) and a suffix denoting the derivation, separated by a hyphen (e.g. NAME-CGFail). Note that names of variables and events are limited to 12 characters. Thus, the name of the derived variable or event will be truncated if necessary. As the parent name can be up to 8 characters long, the first three characters in the suffix will be unique.

Variables and events may come from two sources:

1 They may be maintained in order to perform an analysis. These are failure events, inspection events, limit state variables and variables giving the life time using a specific analysis type.

  Each stochastic parameter in PROFAST maintains a variable with a name as described above. This variable is used to contain the uncertainty description of the parameter.

Note that, as PROFAST develops, more names than are specified here may be added. The full list of stochastic parameters may always be printed using the command PRINT UNCERTAINTY DEFINITION.

All variables and events are listed alphabetically.

B 1 Independent Values

There are only two independent values in PROFAST, denoting the service life:

LifeBegin	Start of the service life
LifeEnd	End of the service life

B 2 Attached to a Fatigue Point

The following variables and events may be attached to a fatigue point. Not all of these will exist at any one time. The active subset depends on the modelling and on the analyses performed.

B 2.1 Analysis Variables

These variables are created/updated when the RUN SN-ANALYSIS and RUN-CRACK-GROWTH-ANALYSIS commands are used.

NAME-CGFail	Crack growth failure limit state function
NAME-CGLife	Time to crack growth failure
NAME-SNFail	SN failure limit state function
NAME-SNLife	Time to SN failure

B 2.2 Events

These events are created/updated when the RUN SN-ANALYSIS and RUN-CRACK-GROWTH-ANALYSIS commands are used.

NAME-CGFail	Crack growth failure event
NAME-SNFail	SN failure event

B 2.3 Stochastic Parameters

These variables are created/updated when the value they contain is created or changed, or when an uncertainty specification is changed.

NAME-1dB	1/B, B: Weibull shape parameter
NAME-a0	Initial crack depth
NAME-acRatio	Aspect ratio (a/c)
NAME-acrit	Critical crack depth
NAME-ASCF	SCF value, Axial
NAME-AtLen	Length of attachment at weld
NAME-aTRF	Transfer function factor = a + b*Hs + c*Hs^2
NAME-bTRF	Transfer function factor = a + b*Hs + c*Hs^2
NAME-c0	Half initial crack length

NAME-c1Pol	Polynomial geometry function, coefficient 1
NAME-c2Pol	Polynomial geometry function, coefficient 2
NAME-c3Pol	Polynomial geometry function, coefficient 3
NAME-c4Pol	Polynomial geometry function, coefficient 4
NAME-c5Pol	Polynomial geometry function, coefficient 5
NAME-c6Pol	Polynomial geometry function, coefficient 6
NAME-c7Pol	Polynomial geometry function, coefficient 7
NAME-c8Pol	Polynomial geometry function, coefficient 8
NAME-CaCc	(Ca/Cc)^(1/m)
NAME-ccrit	Half critical crack length
NAME-cTRF	Transfer function factor = a + b*Hs + c*Hs^2
NAME-DK0	Delta K0, threshold value
NAME-GFactor	Factor on geometry function
NAME-I01	Influence coefficient 01
NAME-I02	Influence coefficient 02
NAME-I03	Influence coefficient 03
etc.	Influence coefficient xx
NAME-I98	Influence coefficient 98
NAME-I99	Influence coefficient 99
NAME-IFactor	Common factor on influence coef
NAME-ISCF	SCF value, In plane bending
NAME-ITime	Crack initiation time
NAME-lCa	ln(Ca), material parameter
NAME-lN0	SN curve, Log cycles at first slope change
NAME-lN1	SN curve, Log cycles, second slope change
NAME-lnA	ln(A), A: Weibull scale parameter
NAME-lnC	ln(C), material parameter

NAME-m0	First slope in SN Curve
NAME-m1	Second slope in SN Curve
NAME-m2	Third slope in SN Curve
NAME-MSRatio	Membrane stress ratio: m/(m+b)
NAME-m	m, material parameter
NAME-MinerSum	Critical Miner sum
NAME-nu0	Number of load cycles per second
NAME-ODiam	Outer diameter
NAME-OSCF	SCF value, Out of plane bending
NAME-RSP	Factor on square modulus of Transfer function
NAME-SFactor	Common factor on all SCF values
NAME-SRange	Constant stress range value
NAME-ThFac	SN curve, Thickness correction factor
NAME-Thick	Thickness
NAME-WFactor	Factor on Weld effect
NAME-Width	Width

B 3 Attached to an Inspection

The following variables and events may be attached to an inspection. Not all of these will exist at any one time. The active subset depends on the modelling and on the analyses performed.

B 3.1 Analysis Variables

These variables are created/updated when the RUN SN-ANALYSIS and RUN-CRACK-GROWTH-ANALYSIS commands are used.

NAME-CGFail	Crack growth failure limit state function
NAME-CGLife	Time to crack growth failure
NAME-INDep	Depth inspection limit state function
NAME-INLen	Length inspection limit state function
NAME-SNFail	SN failure limit state function

NAME-SNLife	Time to SN failure

B 3.2 Events

These events are created/updated when the RUN SN-ANALYSIS and RUN-CRACK-GROWTH-ANALYSIS commands are used.

NAME-CGFail	Crack growth failure event
NAME-INAll	Intersection of all inspection events up to this for the relevant fatigue point.
NAME-INDep	Depth inspection event
NAME-INLen	Length inspection event
NAME-SNFail	SN failure event

B 3.3 Stochastic Parameters

These variables are created/updated when the value they contain is created or changed, or when an uncertainty specification is changed.

The following values are created for an inspection when needed, regardless of the assignment of a repair to the inspection:

NAME-Depth	Depth of crack at inspection
NAME-DPOD	Depth POD curve
NAME-Length	Length of crack at inspection
NAME-LPOD	Length POD curve
NAME-Time	Time of inspection

The following values may appear after a grind repair has been assigned to the inspection:

NAME-1dB	1/B, B: Weibull shape parameter
NAME-a0	Initial crack depth
NAME-acRatio	Aspect ratio (a/c)
NAME-acrit	Critical crack depth
NAME-ASCF	SCF value, Axial
NAME-AtLen	Length of attachment at weld
NAME-aTRF	Transfer function factor = a + b*Hs + c*Hs^2
NAME-bTRF	Transfer function factor = a + b*Hs + c*Hs^2

NAME-c0	Half initial crack length
NAME-c1Pol	Polynomial geometry function, coefficient 1
NAME-c2Pol	Polynomial geometry function, coefficient 2
NAME-c3Pol	Polynomial geometry function, coefficient 3
NAME-c4Pol	Polynomial geometry function, coefficient 4
NAME-c5Pol	Polynomial geometry function, coefficient 5
NAME-c6Pol	Polynomial geometry function, coefficient 6
NAME-c7Pol	Polynomial geometry function, coefficient 7
NAME-c8Pol	Polynomial geometry function, coefficient 8
NAME-CaCc	(Ca/Cc)^(1/m)
NAME-ccrit	Half critical crack length
NAME-cTRF	Transfer function factor = a + b*Hs + c*Hs^2
NAME-DK0	Delta K0, threshold value
NAME-GFactor	Factor on geometry function
NAME-Grind	Depth of grind at inspection
NAME-GThick	Stochastic representation of thickness after repair as the difference between the previous thickness and the grind depth.
NAME-I01	Influence coefficient 01
NAME-I02	Influence coefficient 02
NAME-I03	Influence coefficient 03
etc.	Influence coefficient xx
NAME-I98	Influence coefficient 98
NAME-I99	Influence coefficient 99
NAME-IFactor	Common factor on influence coef
NAME-ISCF	SCF value, In plane bending
NAME-ITime	Crack initiation time
NAME-lCa	ln(Ca), material parameter

NAME-lN0	SN curve, Log cycles at first slope change
NAME-lN1	SN curve, Log cycles, second slope change
NAME-lnA	ln(A), A: Weibull scale parameter
NAME-lnC	ln(C), material parameter
NAME-m0	First slope in SN Curve
NAME-m1	Second slope in SN Curve
NAME-m2	Third slope in SN Curve
NAME-MSRatio	Membrane stress ratio: m/(m+b)
NAME-m	m, material parameter
NAME-MinerSum	Critical Miner sum
NAME-nu0	Number of load cycles per second
NAME-ODiam	Outer diameter
NAME-OSCF	SCF value, Out of plane bending
NAME-RSP	Factor on square modulus of Transfer function
NAME-SFactor	Common factor on all SCF values
NAME-SRange	Constant stress range value
NAME-ThFac	SN curve, Thickness correction factor
NAME-Thick	Thickness after repair
NAME-WFactor	Factor on Weld effect
NAME-Width	Width

B 4 Attached to a Scatter Diagram

The following variables may be attached to a scatter diagram Not all of these will exist at any one time. The active subset depends on the modelling used.

These variables are created/updated when the value they contain is created or changed, or when an uncertainty specification is changed.

NAME-AWS	Factor on sigmaA in Jonswap spectrum
NAME-BWS	Factor on sigmaB in Jonswap spectrum

NAME-CHT	Factor on correlation (Hs,Tz)
NAME-EHS	Factor on mean of Hs
NAME-ETZ	Factor on mean of Tz
NAME-FHS	Factor on Fang & Hogben skewness
NAME-GWS	Factor on Gamma in Jonswap spectrum
NAME-LWS	Factor on L (Ksi) in General Gamma spectrum
NAME-NWS	Factor on N (Zeta) in General Gamma spectrum
NAME-PWS	Factor on Power in wave spreading function
NAME-SHS	Factor on standard deviation of Hs
NAME-STZ	Factor on standard deviation of Tz