COMPUTER MANUAL SERIES No. 23

PRIS-WEDAS

User's Manual to the Web Enabled Data Acquisition System for PRIS

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PRIS-WEDAS

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The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world''.

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USER'S MANUAL TO THE WEB ENABLED DATA ACQUISITION SYSTEM FOR PRIS

INTERNATIONAL ATOMIC ENERGY AGENCY
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FOREWORD

Historically, the IAEA collected nuclear power plant data by sending out questionnaires to its Member States each year. The response used to come mostly in the form of hard copies, which were then manually entered into the Power Reactor Information System (PRIS) by the IAEA staff. In the 1990s, data collection was arranged off-line through electronic file exchange. With advances in computer software, it was decided to make arrangements for data capture directly on-line into PRIS to facilitate data entry for an increasing number of reactors.

The IAEA Web Enabled Data Acquisition System (WEDAS) assists PRIS data providers with an easy to use tool for on-line data entry, resulting in improved data quality and considerable time saving in data input into PRIS.

This PRIS-WEDAS user's manual provides guidelines and detailed information for each of the data items required and facilitates the use of the PRIS-WEDAS application. The purpose of this manual is to ensure PRIS performance indicator data are collected consistently and that the required quality of data collection is assured. It replaces reporting instructions published in IAEA Technical Reports Series No. 428.

The IAEA officer responsible for this publication was J. Mandula of the Division of Nuclear Power.

CONTENTS

1. INTRODUCTION TO THE PRIS DATA STRUCTURE

The Power Reactor Information System (PRIS) is the IAEA database on the world's nuclear power plants. It contains the specifications and performance data of power reactor units. The PRIS database is available free of charge to IAEA Member States through its public website and on-line applications.

PRIS contains information on all power reactors that are in operation, under construction or permanently shut down covering the history of nuclear power since 1954. The data for monthly production and power losses have been recorded in PRIS since 1970. The PRIS database has an open modular structure. The latest status of the structure is shown in Figure 1-1.

The module of reactor specification data supports all other modules except the country data module containing specific data.

In the operational data module the electricity production data also includes information on energy provided by nuclear power plants to non-electrical applications such as district heating, process heat supply and desalination. The data module "Initiating Event Data", which utilises information from selected outage records, has been introduced into PRIS to support probabilistic safety assessment models.

The decommissioning data module contains information about the decommissioning process of shutdown units. The construction data module contains information about the organisation and experience of NPP construction.

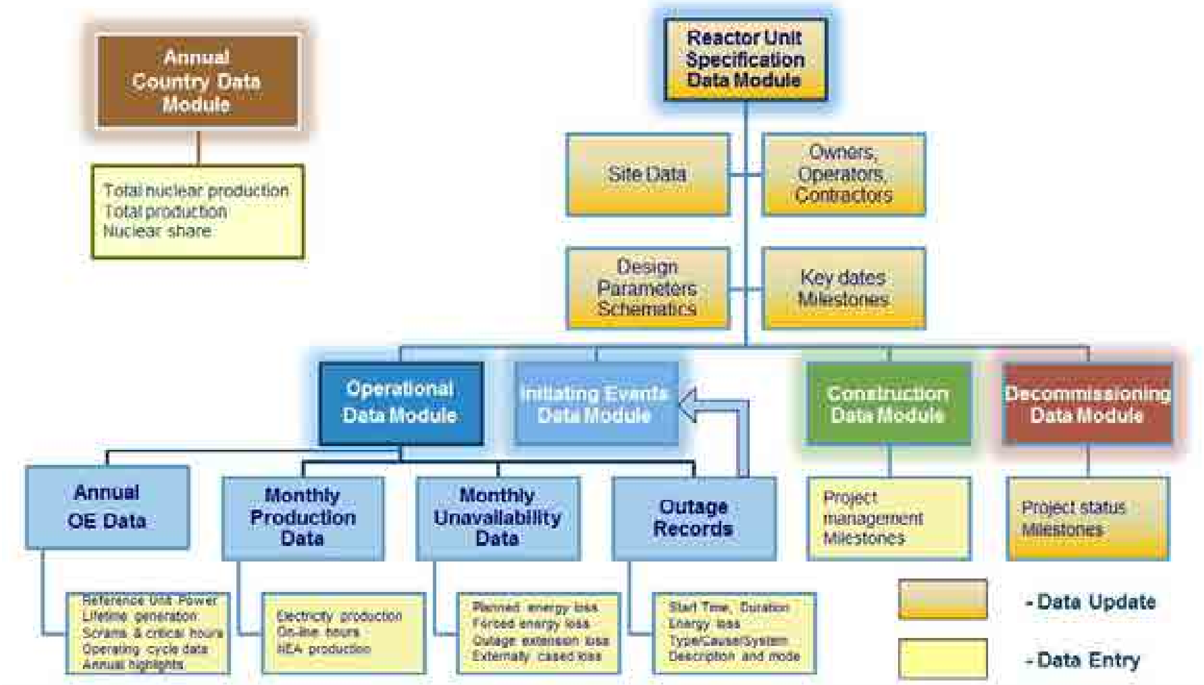


FIG.1-1: Modular structure of PRIS

2. WEDAS APPLICATION

The IAEA-PRIS database is supported by Member States through the officially nominated liaison officers and data providers. The official contact persons are responsible for timely reporting and updating PRIS data. In order to facilitate the data collection process and improve data quality the IAEA has developed the PRIS Web-Enabled Data Acquisition System (WEDAS) as a tool for on-line data reporting. Its address is: http://prisweb.iaea.org alias http://pris.iaea.org/wedas/

The system is accessible via the Internet and serves as the interface between data providers and the PRIS system. WEDAS simplifies data collection and allows data providers to check and correct data before submission to PRIS.

WEDAS is accessible to designated contact persons in Member States, allowing them to provide specification and operational data of their nuclear power reactors to the IAEA. The data provided is verified and approved by PRIS Administrators before its use in PRIS statistics and publications.

This manual provides a complete description of the PRIS data structure, defines all data items, and provides guidelines for reporting PRIS data through WEDAS.

2.1 WEDAS USERS, ACCESS RIGHTS, RESPONSIBILITIES

Each Member State with nuclear power plants submits authorized data into PRIS using WEDAS. The data is normally submitted through the official PRIS contact persons.

WEDAS deals with raw data and is therefore available only to registered users requiring login (see Figure 2-1). The IAEA issues WEDAS registration and provides login: ID and password to the official nominees.

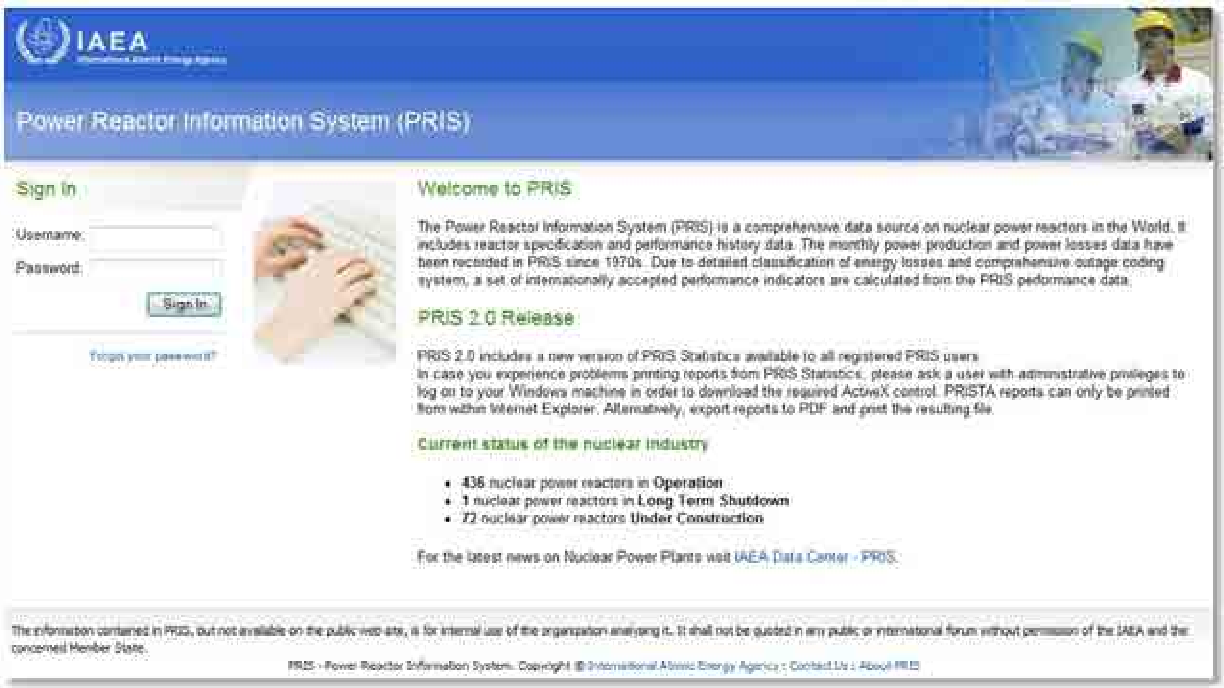


FIG. 2-1: PRIS WEDAS login

For each country one PRIS liaison officer can be registered in WEDAS. The function of the liaison officer is:

- To support official communication with IAEA regarding PRIS;
- To support and supervise the process of data reporting within the country;
- To participate at the biannual meeting to discuss development of PRIS.

The liaison officer has full access to his country's data and read-only access to all raw data of power reactor units within the country. This allows him to supervise data inputs in the country.

In some countries the PRIS liaison officer also serves as the data provider. In this case he has full access to the raw data of assigned reactor units and is responsible for reporting and updating the data.

Utilities operating several NPPs can nominate one data provider for an individual power plant or for more power plants. The data provider has full access to the raw data of the assigned plant(s).

The data providers and liaison officers are responsible for correctness, completeness and timeliness of the reported data. The data is reported on monthly, quarterly or six monthly bases. However the data must be reported at least once a year and before the following deadlines:

- End of January – completion, updating and verification of specification data (basic information, design characteristics, decommissioning data) and country annual data;
- Mid-February - production and outages data.

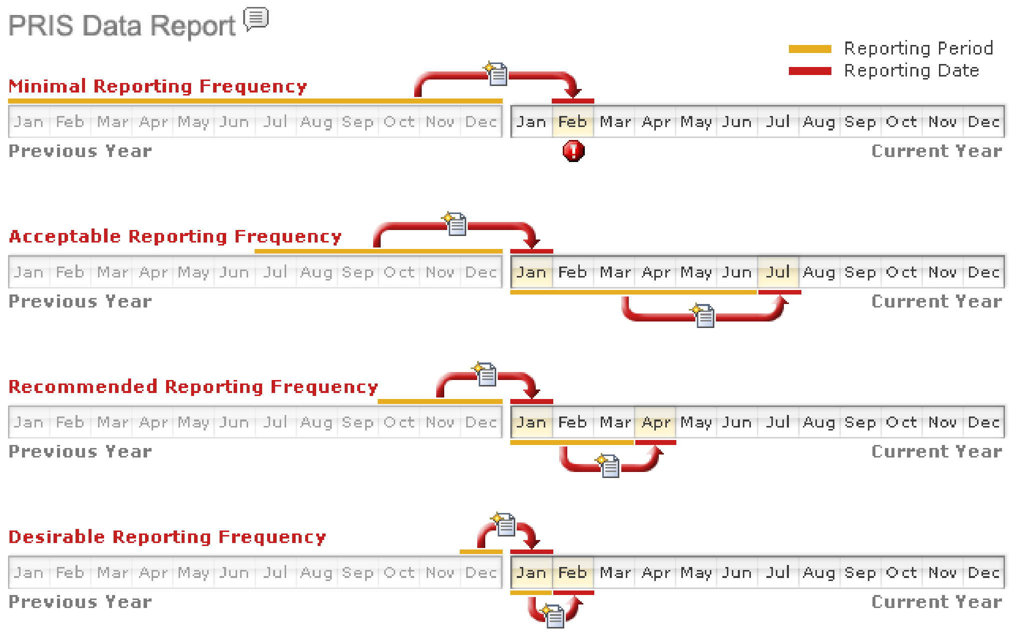


FIG. 2-2. PRIS data reporting frequency

The preferable means of data reporting is through WEDAS. To improve data quality WEDAS has quality and consistency checks to verify the accuracy of the data provided.

Reporting data in Excel spread sheets or MS Access tables is also possible but causes extra effort for the PRIS administrator when it comes to data importing and testing.

All PRIS contact persons registered in WEDAS have full access to the PRIS-Statistics application which allows them to generate statistical reports from PRIS.

2.2 DATA ENTRY SCREENS

After successful login, the WEDAS landing page appears. As default it is open with the choice Reactor Information – see the green bar on the top of WEDAS screen. The other data options are: Country Information, for country level data module, and Add New Reactor for creating a new reactor record in PRIS.

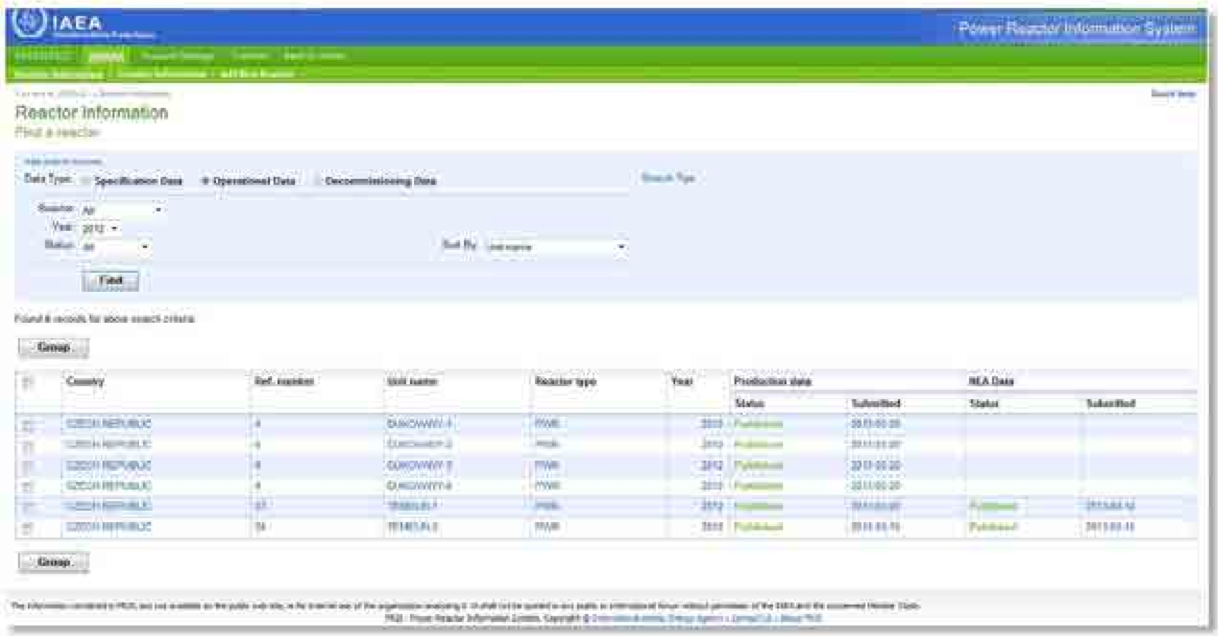


FIG2-3. PRIS-WEDAS Landing Page

The landing screen for reactor information (Figure 2-3) contains radio buttons for selection of reactor unit specific data modules:

- Specification Data;
- Operational Data;
- Decommissioning Data;
- Initiating Events;
- Construction Data.

Activation of data screens for particular reactor unit or year is achieved by clicking on any column of the selected reactor record or year in the landing table.

WEDAS supports selecting more than one reactor unit. Checking the boxes in the first column of the table and clicking on ‘Group’ selects all identified reactor units. To select all reactors in the landing table use the checkbox in the heading of the first column. The data entry screens contain functions for switching the reactor unit within the group to any year within the last ten years.

The landing screen for country information is described in Chapter 3.

Data items for the new reactor screen are described in Chapter 4. WEDAS users can add a new reactor to the PRIS system. The submitted reactor data, however, are not loaded into the PRIS system until the PRIS administrator approves them and switches the data status into 'Published'. Once approved and published, the new reactor record cannot be deleted. For modification of locked data items or for deleting, the new reactor record must be switched back to the 'In process' status.

2.3 FILTERS FOR DATA ENTRY

The WEDAS landing screens contain a table of reactor units which are assigned to the login user. Reactor records in the table are controlled by filters:

- Reactor name;
- Year (only for operational data);
- Reactor status (only for specification data);
- Data status.

The landing screen is open with default setting for filters. In case of operational data the default setting is 'All' except the data status. The default status 'In Progress' helps data providers in identification of pending data entry. This setting can lead to empty table (not shown) in cases where all data has been already submitted. To see reactor records in all data status it is necessary to select particular reactor or particular year. The system does not allow setting all filters as 'All'.

The columns of the landing table can be sorted using 'Sort by'.

2.4 DATA STATUS CONTROL

Data provision through the WEDAS system has four steps:

- **In Progress**: The data are fully under the data provider's control. The data provider can enter or modify the data and check them via consistency tests and indicator calculations. While data are 'in progress', the system and PRIS administrator consider them as unfinished and unauthorised.

  The data remain in WEDAS only and are not used in any of the PRIS outputs;

- **Submitted**: This indicates that a data provider has finished data entry and data can be considered as completed and authorised. Status is changed from 'In Progress' to 'Submitted' by the data provider. Before submitting production data, the data provider is expected to use all consistency tests and performance indicator calculation, which WEDAS provides for data quality assurance. While data are submitted the data provider can see the data, but cannot modify them. In order to correct any later identified discrepancies, the data provider can change the status back to 'in progress'.

  The status 'Submitted' gives the PRIS administrator a green light for data verification and crosschecking. Submitted data remain in WEDAS only and are not used in PRIS outputs;

- **Approved**: When data pass all verification and consistency tests, the PRIS administrator can change the data status to 'Approved'. Data in this status are locked and cannot be edited, modified or deleted.

The data is not yet available for any PRIS statistics and outputs;

- **Published:** When data status is switched to ‘Published’, data are replicated from WEDAS to production tables of the PRIS database and included in all PRIS statistics and outputs. Published data are locked and cannot be edited, modified or deleted (like approved data). If a correction is needed, contact the PRIS administrator who can switch the data back to the “In Progress” status.

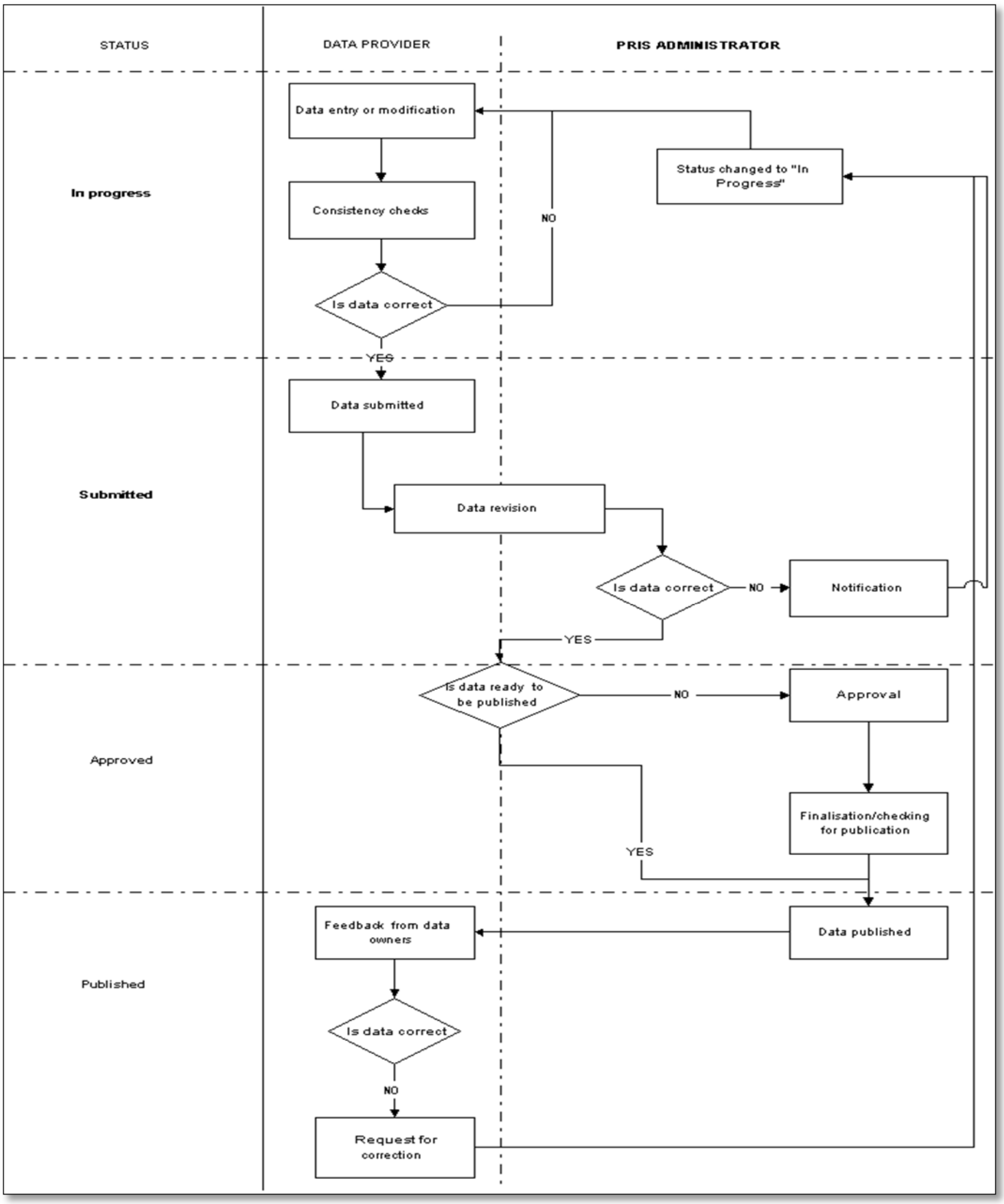


FIG.2-4: PRIS Data reporting process

2.5 ON-LINE HELPS AND TUTORIAL

To support data providers, WEDAS has on-line helps for all data items in all PRIS data modules. On-line helps are under the titles of data items. Titles with on-line help are called ‘active’ titles.

When a cursor is moved above an active title, the title is underlined and a mouse click opens an on-line help window. Using the left arrow of a browser, the window is switched back to a data entry screen.

For the production data module, which is the most complex module of PRIS, special guidelines, labelled PRIS Tutorial, have been developed and integrated into WEDAS. The Tutorial also contains practical exercises for outage coding.

Tutorial is available in the main menu of WEDAS. Data entry chapters from Tutorial are also available directly from data entry screens through the use of the ‘Quick Help’ button in the top right corner of a screen.

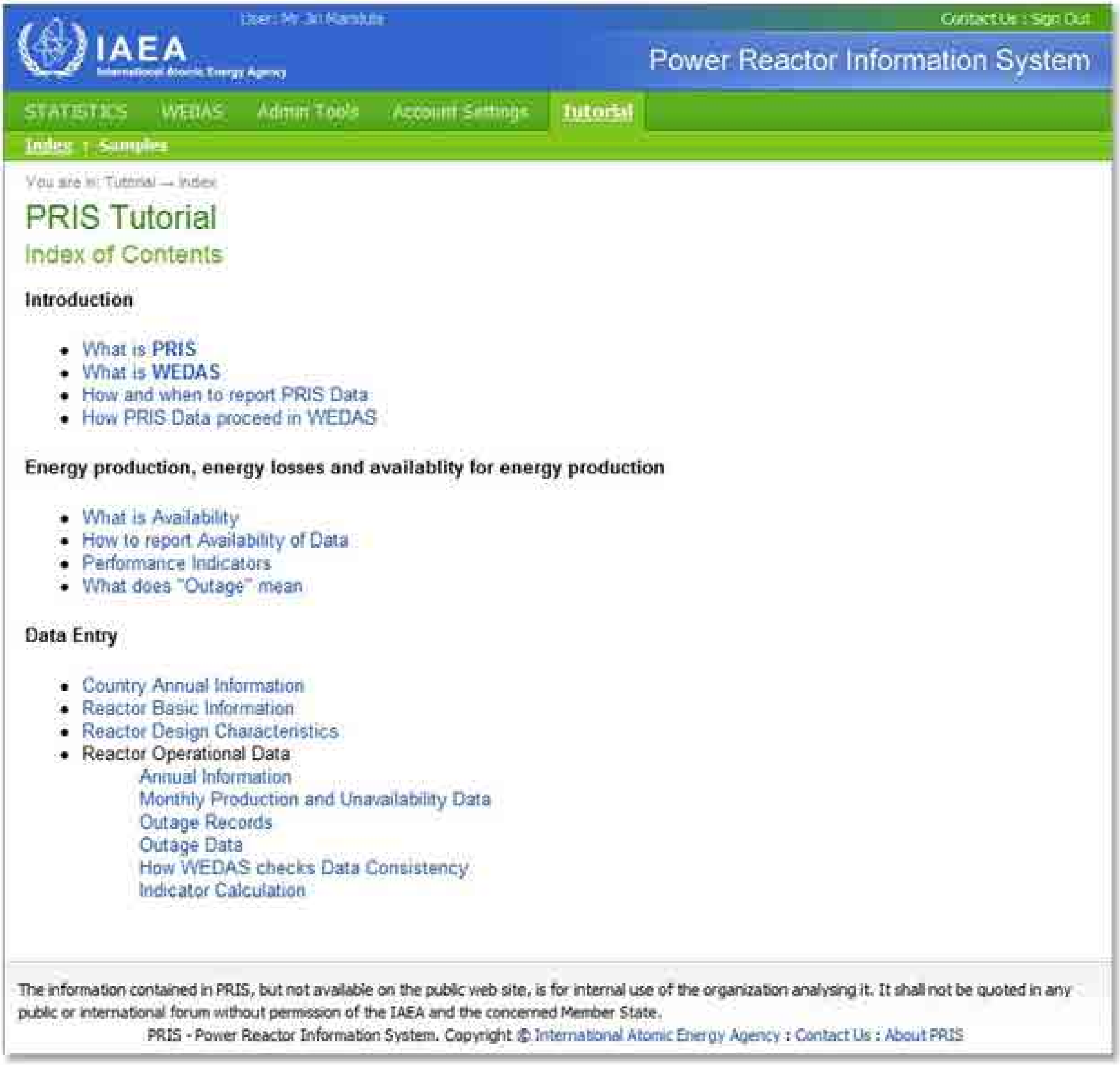


FIG. 2-5: PRIS-WEDAS Tutorial

3. COUNTRY ANNUAL INFORMATION

PRIS provides and shares an overview of nuclear electricity production in individual countries and globally. These data as well as their trends are generally used in nuclear energy analyses.

For a specified year the country information landing screen shows a table with data for each of last 10 years. The default specification is the previous year.

FIG. 3-1: Country data screen

Data are provided annually and should be submitted by February of the next year. If final data are not available by that time, preliminary data can be used as a temporary entry which should be updated when the final data are available.

Year:

A new record for country data is created and activated by entering the 'new' year and clicking on 'Go'. Existing country records can be selected by entering the required year into the year field or by clicking on the required year in the landing table.

Nuclear Production:

The total electrical energy production in [GW·h] from all nuclear power plants operated in a country.

Exported production is also counted.

Country annual data are reported using the official country statistics. Due to possible differences in methodologies in official statistics small differences can exist between the official nuclear productions compared to the sum of electricity production from individual reactor units as reported in PRIS.

Total Production:

The total domestic electricity production in [GW·h] from all power plants (coal, gas, oil, hydro, nuclear, renewables…) operated in the country.

Exported production from these plants is also counted. Imported energy is not counted.

Type:

Selection between NET and GROSS production data.

Preferable data is NET production, which is the electricity supplied to the grid. However some countries have a problem reporting a NET value for total production. For this reason the system allows reporting GROSS values.

The selection **relates to both nuclear and total production**. It is important to note that if total production is reported as GROSS production, the nuclear production should also be GROSS regardless the NET monthly data.

Clarifying notes:

(a) Net generation is the amount of electricity generated by a power plant that is transmitted and supplied to the grid for consumer use. It is measured at the unit outlet terminals, i.e. after deducting the electrical energy taken by unit auxiliaries and the losses in transformers that are considered integral parts of the unit.
(b) Net generation is less than the total gross power generation as some power produced is consumed within the plant itself by power auxiliary equipment such as pumps, motors and pollution control devices.
(c) Gross electricity production is the total electricity produced by an electric power plant. It is measured at the output terminals of the turbine generator, i.e. including the amount of electricity used in the plant auxiliaries and in the transformers.

Nuclear Share:

A read-only calculated value in percentage of nuclear share, which is defined as the ratio of the nuclear electricity production to the total electricity production from all sources in a country.

Comments:

This text box is for additional information. Data providers can use this data item for:

- Informing whether the data are final or preliminary;
- Reference to data source;
- Reasons why net nuclear production is not identical to a sum of electricity production of individual reactor units in monthly data records.

4. SPECIFICATION DATA

In PRIS, each reactor unit is identified by a set of specification data. The purpose of specification data is to provide comprehensive information about technical and design characteristics, location, history, ownership, and main events of reactor units.

Specification data in PRIS are divided into separate tabs:

- Basic information;
- Design characteristics;
- Connection to non-electrical application units (*shown only for units with NEA*);
- Schematics;
- Milestones.

Specification data should reflect the current situation at a reactor unit. PRIS does not maintain (except the Reference Unit Power) history of specification data. It is a responsibility of data providers to keep specification data updated. Specification data should be updated immediately after a change in specification. WEDAS registers the date of the latest update.

Even if no update is needed for specification data, a regular verification is required mainly for basic information (at least once per year) and design characteristics (at least once per five years).

The same data status categories as described in Chapter 2.4 are used for specification data but with a significant exception that some data items are editable even in the 'Published' status. It means that all updates are done directly in PRIS production tables and are reflected in all PRIS statistics and outputs starting the next day after the change. The key data items, for example reactor name, reference number, reactor type, or reactor status, are locked when 'published'. To update information in these data fields, the PRIS administrator should change the data status to 'in progress' to allow a data provider to modify content.

4.1 BASIC INFORMATION

Reactor basic information consists of reactor identification, status (under construction, in operation etc.), suppliers, historical milestones and capacity parameters. These data are used for reactor classification.

Some data items are highlighted by red asterisks. Those data items are obligatory and should be completed. Assignment of red asterisks depends on the status of a power reactor.

Data providers are required to update the data in the case of any modification. Specification data should be reviewed and verified at least once per year. To verify the data, push the button "Mark as verified".

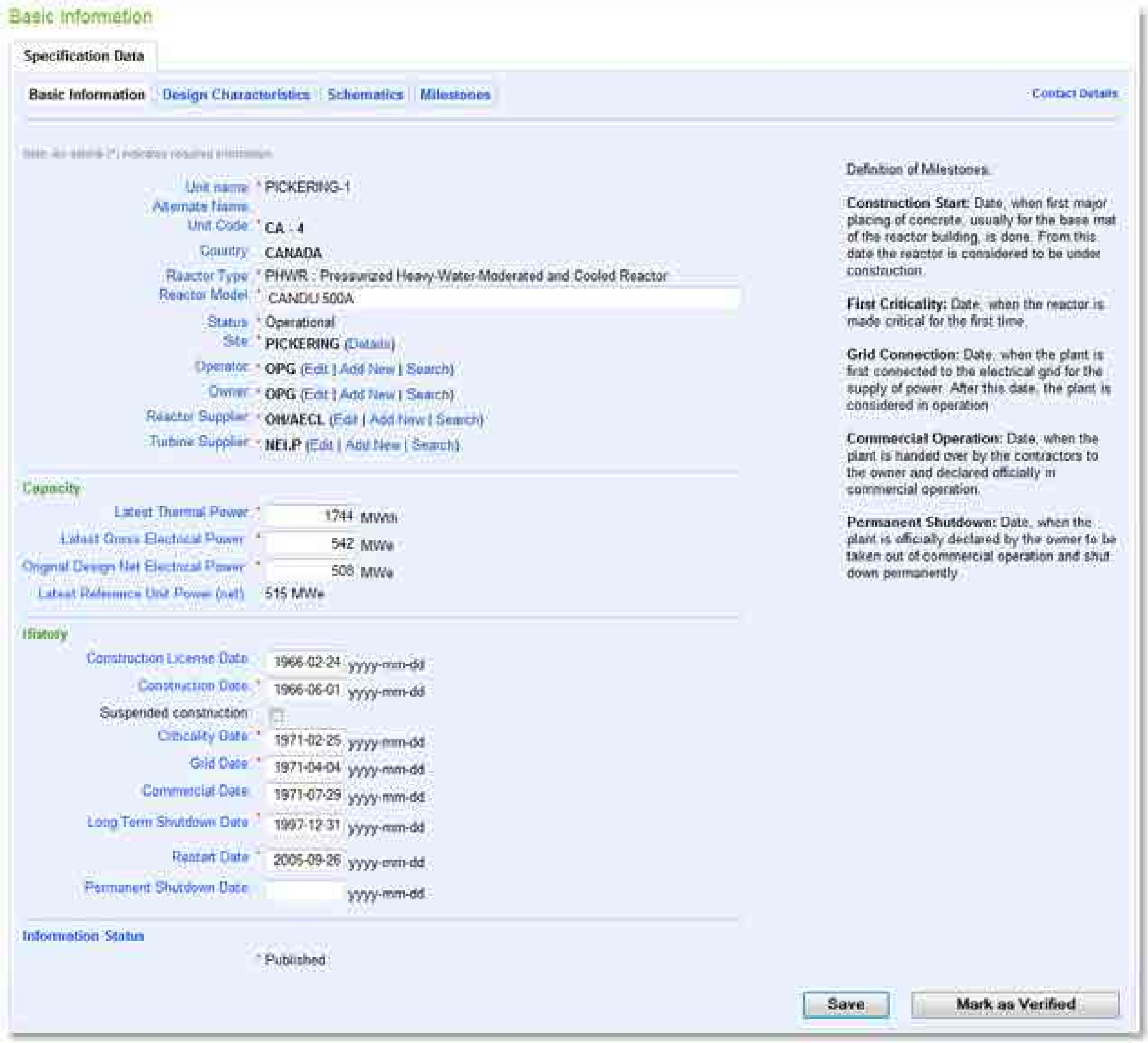


FIG. 4-1: Reactor unit basic information

4.1.1 Reactor identification

This part of the specification data contains the main information required for reactor unit identification. Those pieces of information are usually used for reactor categorisation in PRIS statistics and reports.

Unit name:

It is the name given to the nuclear power plant, and is an important reference in PRIS.

Unit name is a combination of name and numbers including spaces and hyphens. The structure of nomenclature used in the PRIS systems is as follows:

- NAME [␣StationID][-UnitID]

  Note: Parts in square brackets [...] are optional.

Examples of names: EMBALSE; DOEL-1, GUNDREMMINGEN-B, QINSHAN 2-1, DUNGENESS B-1

Clarifying notes:

(a) StationID and UnitID can be a numerical or alphabetic character.
(b) PRIS unit name is not necessarily derived from the 'site name'. In some cases multiple stations with different names are located on the same site.

Alternate name:

It is the alternate name used for the power reactor unit. Use this data item only if applicable.

Sometimes reactor names have short and long (official) versions. This data field allows introduction of such names.

Unit code:

Unit code consists of the country ISO code and the PRIS reference number.

The code is assigned to the reactor unit when the reactor record is created and cannot be changed.

The reference number can be a combination of numeral and alphabetical characters.

Clarifying notes:

(a) The reference number is assigned by the PRIS Liaison Officer or data provider responsible for the data of a referred reactor unit.
(b) The reference number should be unique within the country.
(c) Unit code can be used as a key data field in the PRIS database, nevertheless PRIS contains an internal key (Reactor ID) for internal links.

Country:

Read-only information – name of the country where the station site is located.

Country is assigned to the reactor unit when the reactor record is created and cannot be changed.

Reactor type:

Nuclear power reactors are classified into types based on principal concept of design, moderator material, coolant or nuclear reaction.

Reactor type should be selected from the list with the IAEA classification for type of reactor, as below:

- BWR – Boiling Light-Water-Cooled and Moderated Reactor;
- FBR – Fast Breeder Reactor;
- GCR – Gas Cooled, Graphite Moderated Reactor;
- HTGR – High Temperature Gas Cooled, Graphite Moderated Reactor;
- HWGCR – Heavy Water Moderated, Gas Cooled Reactor;
- HWLWR – Heavy Water Moderated, Boiling Light Water Cooled Reactor;

- LWGR – Light Water Cooled, Graphite Moderated Reactor;
- PHWR – Pressurized Heavy Water Moderated and Cooled Reactor;
- PBMR – Pebble Bed Modular Reactor;
- PWR – Pressurized Light Water Moderated and Cooled Reactor;
- SGHWR – Steam Generating Heavy Water Reactor.

Reactor model:

The reactor model identifies a specific reactor design series within a particular reactor type. All models of the same reactor type usually have the same basic design characteristics (moderator and coolant type and form).

Clarifying notes:

(a) Because of the wide variety of reactor models this data field is free text. It is expected to use an official and short specification of the model.
(b) The role of the PRIS administrator is to unify spelling of the same reactor models in PRIS.
(c) Examples of reactor models: Magnox, AGR for GCR or VVER V-213, Konvoi, EPR, for PWR.

Reactor status:

Classification of reactor status is based on historical phases of power reactor life cycle, from a planning phase, through construction, and operation to permanent shutdown.

Reactor status should be selected from the drop-down list. A logic applied on the list offers only those categories that can follow the current status of a reactor.

Timely update of reactors status helps IAEA and nuclear industry keeping track of nuclear power development. Any update of this data item requires communication with the PRIS administrator who should change the Basic Information data status to 'in progress' to allow reactor status modification.

Definitions:

Planned reactor: A reactor is considered as planned from the date of application for construction license to the date of construction start (when the first major placing of concrete, usually for the basement of the reactor building, was carried out).

Suspended plan: Planned project was suspended and a new date for construction start has not been specified.

Cancelled plan: Planned project was definitely cancelled before construction start.

Under construction: A reactor unit is under construction from the construction start date to the date of first grid connection.

Suspended construction: Construction of a reactor was suspended and a new date for construction start has not been specified.

Cancelled construction: Construction of a reactor was definitely cancelled before the construction was finished.

Operational/In operation: A reactor is considered as 'operational' or 'in operation' from its first grid connection to permanent shutdown.

Thus, when a reactor is temporarily not generating electricity because of outages for, e.g. refuelling, maintenance, repair, large refurbishment or political decision, the reactor is still categorized as operational. The only exception to this classification is when the reactor’s status is declared as 'long-term shutdown', then it is excluded from the list of operational reactors even though it has not yet reached permanent shutdown.

Long-term Shutdown: Reactor is considered in long-term shutdown status from the long-term shutdown date to the restart date, if it has been shut down for an extended period (usually more than one year) and any of the following conditions has occurred in the early period of shutdown:

- no firm restart date or recovery schedule has been established, but there is the intention to re-start the unit eventually; or
- restart is not being aggressively pursued (there is no vigorous onsite activity to restart the unit).

This status may be for example due to technical, economical, strategic or political reasons. This status does not apply to long-term maintenance outages, including unit refurbishment, if the outage schedule is consistently followed, or to long-term outages due to regulatory restrictions (licence suspension), if restart (licence recovery) term and conditions have been established. Such units are still considered "operational" (in a long-term outage).

The alternative term for ‘long-term shutdown’ is ‘suspended operation’ which is more consistent with other life cycle stages (planning and construction) of reactor units.

If an intention not to restart the shutdown unit has been officially announced by the owner, the unit is considered "permanently shut down".

Permanent Shutdown: A reactor unit is permanently shut down when it is officially declared by the owner to be taken out of commercial operation and shut down permanently.

Clarifying notes:

(a) The first grid connection date is the date, when the plant was connected for the first time to the electrical grid to supply electricity. After this date, the plant is considered in operation.

(b) Cancellations or suspensions of projects may occur when the plant is under construction or planned. Therefore, the specific condition of the plant when the project was cancelled should be classified as below:

- The status is suspended when there is no definite decision and the plant may restart construction or put in the planned list in the future;
- The status is cancelled when there is a definite decision and the plant will not restart construction or be in the planned list any longer.

Site:

Site name specification. This is the name of a locality that can host more than one reactor unit. A reactor unit name is usually derived from the site name but there are cases where site and reactor unit names are different.

Site specification contains additional information about a location of the nuclear power plant:

- Address of the plant;
- Name of city near the nuclear power plant;
- State/province of the country;
- Country – assigned when the reactor record is created;
- Geographical coordinates (latitude and longitude) of the site;
- Climatic zone – selection from: Subarctic; Mild temperature; Subtropical; Tropical;
- Location – selection from: Inland near a lake; Inland near a river; Seacoast.

FIG. 4-2: Site specification

The site specification screen also contains a map which shows the location of the site after coordinates have been filled in. The map helps as verification of correctness of coordinates.

Operator:

A short name of the current company that operates the nuclear power plant.

Operator specification contains additional information:

- Full name of the operator;
- Address of headquarters;
- Website – URL of an official website of the company.

Owner:

A short name of the owner of the nuclear power plant.

Owner specification contains additional information:

- Full name of the owner. In case of consortium of more companies the names of all companies and their share;
- Address of headquarters of the company having majority share in ownership;
- Website – URL of an official website of the company with majority share in ownership.

Reactor supplier:

A short name of the main supplier of the reactor including the nuclear steam supply system.

Note: Reactor supplier is not always identical with the reactor pressure vessel manufacturer.

Reactor supplier specification contains additional information:

- Country of origin of the company
- Full name of the company

Turbine supplier:

A short name of the main supplier of the turbine generator (TG).

Turbine supplier specification contains the following additional information:

- Country of origin of the company
- Full name of the company

*4.1.2 R***eactor unit capacity**

The reactor capacity is an important part of reactor specification. It is specified as thermal and electrical capacity. The capacity values (especially the Reference Unit Power) influence calculation of many PRIS statistics and performance indicators. Its timely update is necessary for PRIS output correctness.

Latest Thermal Power:

The reference thermal power of the plant expressed in thermal megawatts [MW_{th}].

The reactor thermal power is the net heat transferred from the fuel to the coolant.

This value should reflect any change in fuel design or reactor core arrangement.

Latest Gross Electrical Power:

The reference gross electrical power of the plant expressed in electric megawatts [MW(e)] .

It is the maximum electrical power that could be maintained continuously throughout a prolonged period of operation under reference ambient conditions. The gross electrical power is measured at the output terminals of the turbine generator, i.e. including the amount of electricity used in the plant auxiliaries and in the transformers.

This value should be updated whenever the reference unit power is changed during operation.

Original Design Net Electrical Power:

The original design net electrical power is the unit electrical output after deducting the self-consumption power assumed by the original unit design, no matter if it has ever been routinely achieved during operation.

This value does not reflect possible power changes during subsequent operation in a specific environment of a site.

Latest Reference Unit Power (RUP):

No entry required. This is read-only information about the latest Reference Unit Power as updated through operational data – see Chapter 5.1.1.

The Reference Unit Power (net electrical capacity) expressed in MW(e) is the maximum (electrical) power that could be maintained continuously throughout a prolonged period of operation under reference ambient conditions.

The power value is measured at the unit outlet terminals, i.e. after deducting the power taken by unit auxiliaries and the losses in the transformers that are considered integral parts of the unit.

The reference unit power is expected to remain constant unless following design changes, or a new permanent authorization, the management decides to amend the original value.

4.1.3 Reactor unit history

Specification of key dates provides a brief overview of reactor unit history. The selected dates are important milestones and represent the time boundary between the different status periods of a reactor during its lifetime.

Construction Licence Date:

The construction licence date is a date when application for construction licence has been submitted.

From this date the reactor should be considered as a planned reactor and reported into PRIS.

Construction Start Date:

The date when the first major placing of concrete, usually for the base mat of the reactor building, is carried out.

From this date the reactor is considered to be under construction.

Clarifying notes:

(a) Current definition of construction start is the first concrete pouring for the main base mat of the reactor building. Due to new technologies and the modular construction of a new NPP a significant part of the nuclear island budget (more than 40%) is spent before the first concrete is laid. For this reason it is proposed to use Authorisation to Proceed (ATP) as the beginning of construction for plants using modular construction.

(b) For floating NPP the construction start date is the beginning of platform construction.

Suspended construction:

The check box for activation of dates for the suspended construction period which is defined as a time period of plant Construction without any progress in the project schedule and without any construction activity at a site.

In case the construction was suspended for some period the following dates should be specified:

- Construction suspended date
- Construction restart date

Construction Suspended Date:

The start day of the suspended period

Construction Restart Date:

The end day of the suspended period, usually when the new contract for finishing the construction was signed.

First Criticality Date:

The date when the reactor was made critical for the first time.

It is an important milestone in plant commissioning.

Grid Connection Date:

The date, when the plant is first connected to the electrical grid for the supply of power.

After this date, the plant is considered to be in operation.

Commercial Operation Date:

The date when the plant is officially declared commercial by the owner.

Clarifying notes:

(a) To declare commercial operation, the owner should fulfil all obligations prevailing in the country (e.g. nuclear operating license, successful trial operation, other required licences of the local regulatory authorities, etc.).
(b) The period from the first grid connection to the commercial date is called as 'trial operation'.
(c) All PRIS performance indicators are calculated from the commercial date to eliminate the influence of trial operation.

Shutdown/Cancellation Date:

Shutdown/ Cancellation date signifies the date when the plant is officially declared to be shut down by the owner and taken out of operation permanently.

For cancelled projects (when a reactor is planned or under construction) it is the date when the project is declared to be cancelled.

4.2 DESIGN CHARACTERISTICS

The NPP design characteristics represent a fundamental part of the PRIS database. They provide important information on the main components of a NPP unit, such as the reactor or turbine, briefly describe safety and essential auxiliary systems, and list technical specifications of significant plant equipment.

The objective of the unit design characteristics is to provide a consistent overview of design features and technical specifications of the reactor units stored in the PRIS database. The characteristics serve as the most comprehensive information on the design of all operating, under construction, and shutdown units worldwide.

In combination with other PRIS data and outputs, such as production data, outage data and performance indicators, design characteristics offer an important tool for various performance analyses.

The classification system enables the appropriate characteristics to be used as convenient selection or filtration criteria for choosing reactor units suitable for a particular analysis, thereby improving the relevance of such analyses.

The PRIS set of NPP design characteristics are defined and described in detail in the publication IAEA-TECDOC-1544: Nuclear Power Reactor Design Characteristics.

The characteristics have been organised in four main groups: Primary Systems, Secondary Systems, Spent Fuel Storage and Non-Electrical Applications. In these main groups, systems subgroups have been arranged and named according to usual plant equipment configuration and terminology.

Figure 4-3 shows a part of data entry screen for primary systems.

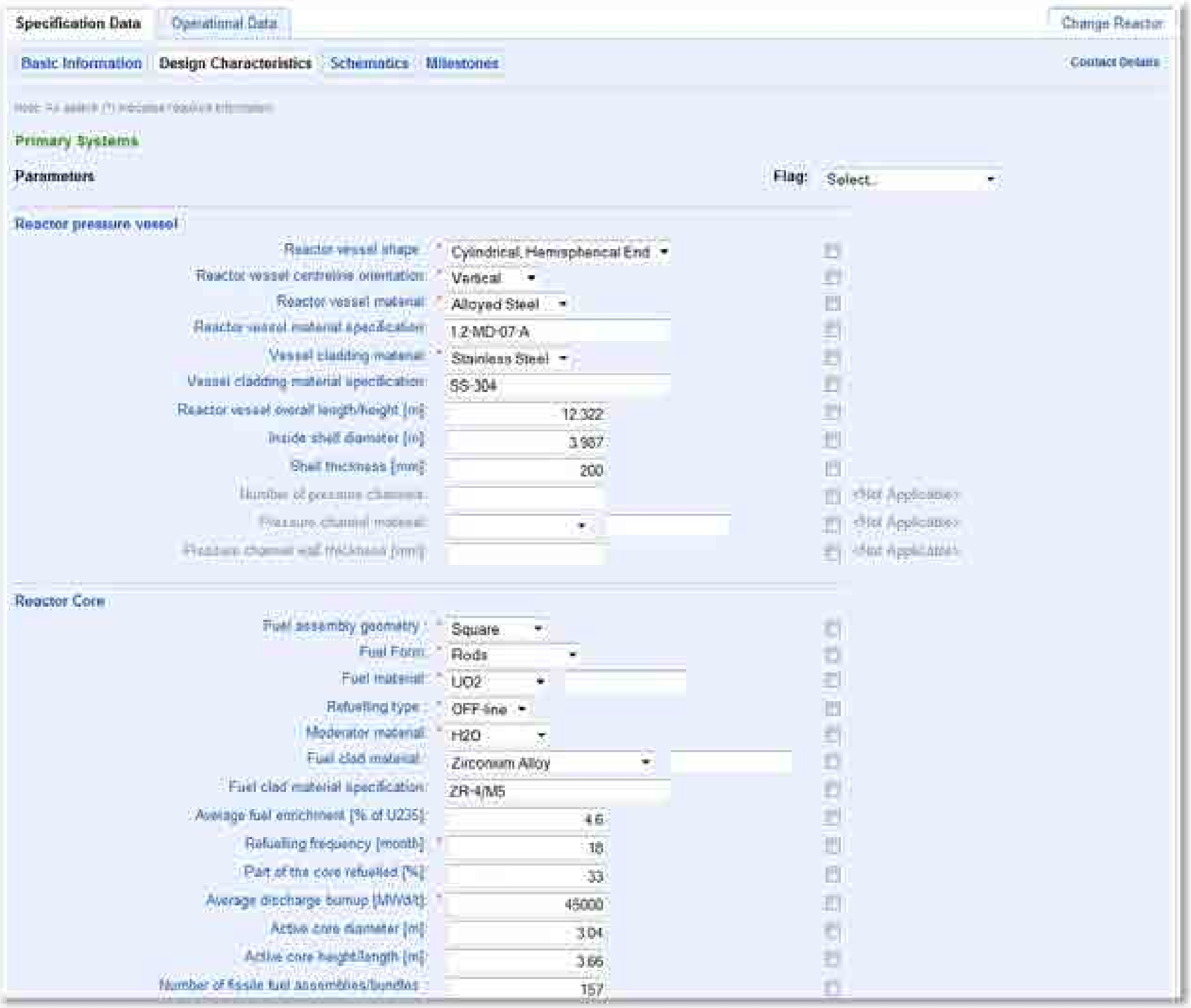


FIG.4-3. Design characteristics

Currently the design characteristics in PRIS are a standard set of 139 parameters. All parameters have on-line help and definitions under the parameter name.

Wherever possible, multiple choices of the design characteristics (based on existing or known design features) have been included. The choices provide hints for data providers on the data to be entered, Instead of typing the data in a text window; the data provider can simply select the most appropriate option from a pop up menu.

Because of the variety of possible designs, the multiple choices are not meant as the only possible choices. The list is open, and it is expected that while completing the database, other options may be found missing. In such cases, the data providers can make comments to the database administrator proposing or requiring new options, and the administrator can amend the multiple choice menu.

When filling design parameters the save action verifies that the required design parameters have appropriate values.

Significant characteristics are mandatory in PRIS and are indicated by red asterisks. When the values for mandatory parameters are not entered, or the values are outside the normal range, the save action will raise a red warning box. The warning message will state ‘Data could not be saved’. The parameter(s) with invalid or missing data will be highlighted in red.

When the data value entered is outside the specified normal range, the user may discover the valid range by hovering over the input field and reading the range description in a popup, i.e. 'Valid Range [1-70]'. These checks are designed to catch data entry errors. If the correct value is outside the range, please use the 'contact us' feature.

There are circumstances where data is not available or not applicable for the required parameters. A 'Flag' selection feature is provided for these cases, to override the data checks and allow other data to be saved. The design parameter can be marked 'not applicable' (the parameter is not relevant for a reported reactor type) or 'not available' (the parameter is relevant but not known and will be specified later). To override the checks, select the parameter's checkbox and then select the appropriate 'Flag' option.

The save action also verifies any parameter marked as 'not applicable' or 'not available' is not allowed to have data entered. The flag can be cleared when applicable value is available: select parameter's checkbox, and then select 'clear flag' choice in the 'Flag' selection list.

4.3 CONNECTED NON-ELECTRICAL APPLICATIONS

As a separate part of design characteristics the reactor units with non-electrical applications (NEA) have a screen with read-only information about NEA units connected to the reactor units. For details regarding NEA units see Chapter 6.

The NEA units are specified by:

- NEA unit name;
- Type;
- Service start date.

4.4 SCHEMATICS

In addition to the design specification data, the PRIS database can accommodate other descriptive data, such as unit system schematics and flow diagrams, local maps and photographs of the unit site. These images can provide a comprehensive picture of unit design, technology and system configuration and also give a clear idea of unit location, appearance and nearby setting.

Appropriate unit schematics or drawings would enhance applicability of the design characteristics to the above purposes. The following types of images, at least, should be included in the PRIS database:

- A simplified or functional cross-section of the containment/reactor building, including the main components and the pressure suppression system;
- Operating flow diagrams of the primary system with all the main components (reactor, RCP, loops, steam generators, pressurizer etc.) including the ECCS (pumps, tanks, piping) and connections of the ECCS to the primary circuit. The diagrams should show at least the components included in the primary system design characteristics;
- Any additional diagrams and schematics (for example those of the balance-of-plant systems) or technical photos can be provided if available or found useful by the NPP personnel.

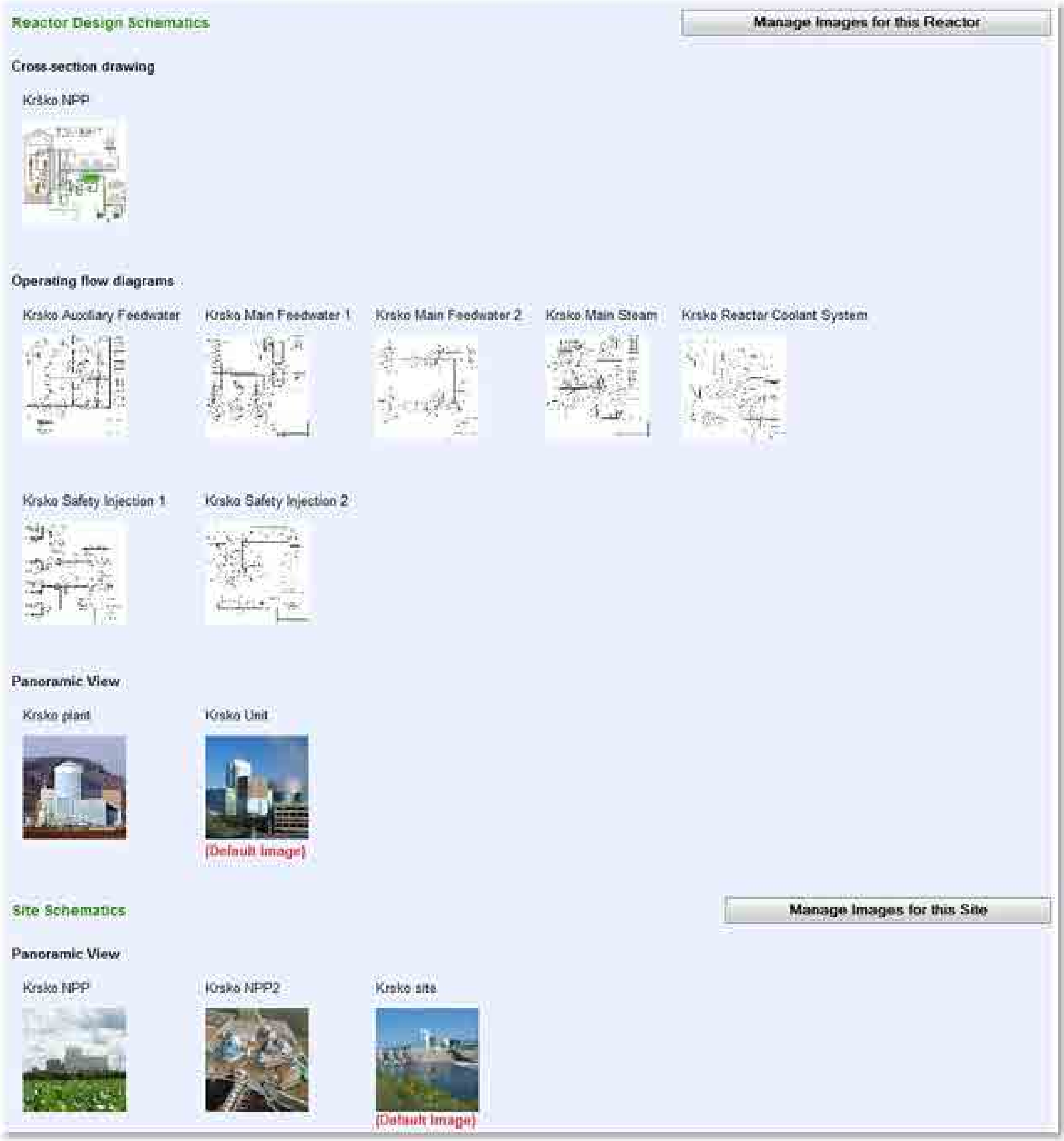


FIG. 4-4. Examples of schematics

An image can be uploaded and assigned either to one particular reactor unit or to a plant site. When assigned to the site, all reactor units of the site share the image.

The function **Manage Images for this Reactor**, available on the left part of the schematics screen, supports image uploading, administration and editing on the reactor unit level while the function **Manage Images for this Site** does the same on the site level. **Manage All Images** deals with all images available to a data provider.

The image management functions open a table of existing images either for a reactor or a site. This table contains already uploaded images and related information and image functions (view, edit, delete).

FIG. 4-5: Image management screen

The table allows selection of one default image for the reactor unit or site. The reactor default image is used for the reactor report on the public PRIS website and for reactor dashboard reports. The site default image is used for plant images on the PRIS website home page and for the reactor report if reactor default image was not selected.

The function **Attach Existing Image** provides the possibility to assign an already uploaded image to the reactor unit/site.

The function **Attach New Image** supports uploading a new image into PRIS. To upload the image a file location should be selected through the **Choose File** button and the file explorer. The size of an image cannot exceed 700 kB.

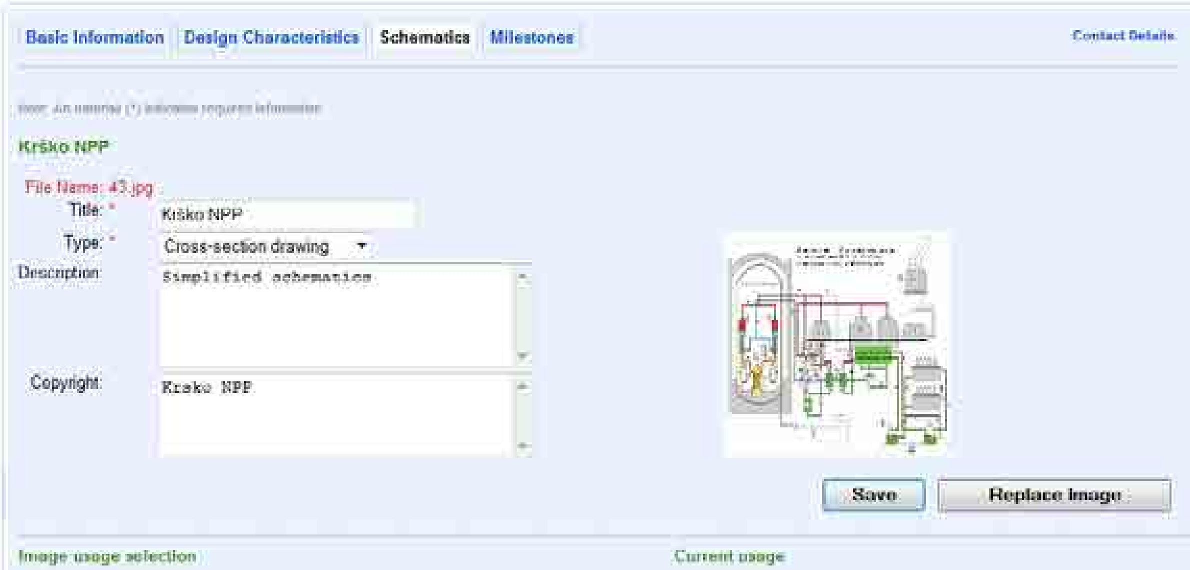


FIG. 4-6: Image uploading or editing screen

When a new image is successfully uploaded into PRIS the following information should be specified:

Title:

The title of the image should be unique in PRIS. It is recommended to use combination of reactor/site name and additional specification.

The screen also contains the internal file name under which the image is stored in PRIS.

Type:

Selection from the pop-up menu:

- Panoramic view
- Schematic diagram
- Cross-section drawing
- Operating flow diagram
- Map
- Technical photo

Description:

Text filed for additional information about content of an image.

Copyright:

Reference to the source or author of the image.

The uploaded image can be assigned to other reactor units or sites under the control of the data provider. For this purpose WEDAS provides a table "Image usage selection" of all reactor units and sites under the image specification. Assignment is done by marking a checkbox on the left of the reactor/site names.

The right part of the table "Current usage" contains a list of reactors/sites to which the image has been already assigned including information who added the image into PRIS.

The function **Replace Image** provides a possibility to replace an existing image with a new one while keeping all specifications and assignments.

4.5 MILESTONES

The Milestones data screen provides the possibility to specify important operational events, design modifications, major refurbishments or decisions that had a significant impact on the reactor unit operating history.

FIG. 4-7: Milestone data screen

A new milestone can be added via the function: Add Milestone

The milestone record is specified by the following data items:

Category:

Selection of the milestone category from the following list:

- Power up-rating
- Power de-rating
- Licence renewal
- Major component/system replacement (SG, I&C, TG …)
- Major refurbishment for an extended period
- Major external events (earthquake, flooding…)
- Regulatory restrictions
- Political decisions
- Other

Clarifying comments to be provided in a separate data field if ‘other’ is selected.

Date:

The date of the milestone in the format YYYY-MM-DD or just year YYYY.

Usually it is the date when an event or decision occurred or when a modification was implemented.

Description:

The text field for more detailed description of the milestone.

For every milestone WEDAS allows to add links to the internet sites or to attach documents with more detailed information.

The PRIS database is connected to the IAEA Incident Reporting System (IRS) which contains detailed reports about operational events at reactor units. The milestone screen contains a list of reactor specific events reported into IRS. The list consists of an incident date, title and short abstract. Please refer to IRS for additional information.

5 OPERATIONAL DATA

5.1 OPERATING EXPERIENCE DATA

The Operating Experience (OE) data screen contains information on the general performance of the plant and significant factors affecting energy generation over the year. The annual information should be updated when necessary (for instance for revision of reference unit power) but finalized after the end of a reported year. OE data have five sections.

FIG. 5-1. Operating experience data screen

5.1.1 Reference Unit Power

The reference unit power (RUP) is the maximum electrical power that could be maintained continuously throughout a prolonged period of operation under reference ambient conditions. The power value is measured at the unit outlet terminals, i.e. after deducting the power taken by unit auxiliaries and the losses in the transformers that are considered integral parts of the unit.

The reference ambient conditions are environmental conditions representative of the annual mean (or typical) conditions for a unit. It is expected that historical heat sink temperatures will be used to determine the reference ambient conditions. The same reference ambient conditions will generally apply for the life of the unit. Periodic review of these reference conditions is not required.

RUP determines the reference energy generation (REG) which is calculated by multiplying RUP by the period hours. REG is expressed in units of megawatt-hours (electric).

RUP at the end of previous year:

Read-only value of RUP taken from a production record for December in the previous year.

Reference Unit Power revision in a reporting year:

This function allows revising the RUP value in a reporting year. The revised value of RUP is stored in a related monthly production record. For this reason the function is active only when both operating experience data and at least one monthly production data record are in the status 'In Progress'. RUP revision can be applied only to those months for which status is 'In Progress' in the production data screen.

If RUP is modified due to a power up-rating project, more detailed information of the project should be provided.

RUP revision requires the following information:

- Selection of a month from which the RUP value is applicable;
- Specification of new value for RUP: Enter a new reference unit power (net capacity in MW(e)) that is foreseen to be permanent since the selected month. Note that regulatory limitations for the net reference unit power of non-permanent nature should not be reported here but as a partial outage due to regulatory limitation;
- Selection of type of revision:
  - Power up-rate (Power Up-rate due to technical modification)
  - Power de-rate (Reduction of RUP due to technical limitation or regulation)
  - Results of new tests (Result of new tests of plant efficiency)
  - Recalculation (Recalculation to updated environmental condition or modified systems)
  - Correction (Correction of an incorrect value provided by mistake);
- Power up rating requires selection of a power up-rate type:
  - Improved measurement (<2%): *Measurement uncertainty recapture power up-rates* are less than 2% and are achieved by implementing enhanced techniques for calculating reactor power. This involves the use of state-of-the-art feed water flow measurement devices to more precisely measure feed-water flow, which is used to calculate reactor power. More precise measurements reduce the degree of uncertainty in the power level, which is used by analysts to predict the ability of the reactor to be safely shut down under postulated accident conditions.
  - Stretch power up-rate (2-7%): *Stretch power up-rates* are typically up to 7% and are within the design capacity of the plant. The actual value for percentage increase in power a plant can achieve and stay within the stretch power up-rate category is plant-specific and depends on the operating margins included in the design of a particular plant. Stretch

power up rates usually involve changes to instrumentation set points but do not involve major plant modifications
  - Extended power up-rate (>7%): *Extended power up-rates* are greater than stretch power up-rates and have been approved for increases as high as 20%. These up-rates require significant modifications to major balance-of-plant equipment such as the high pressure turbines, condensate pumps and motors, main generators, and/or transformers;
- Main modification selection - in case the RUP revision is related to technical modifications, <u>one or more</u> areas where modifications have been implemented should be selected in the following categories:
  - Fuel modification or reactor core arrangement;
  - Primary systems (steam generators, drum separators, main coolant pumps …);
  - Balance-of-plant (turbine, main generator, condenser, heat exchangers, feed-water systems …);
  - Instrumentation and control systems
- Description - it is required to provide more details why RUP has been changed;
- Attachment - for additional details, it is possible to upload a related publication.

More than one revision can be specified during the reporting year.

When month is specified, all data fields with red asterisks should be duly filled in. WEDAS does not allow saving when not specified.

WEDAS has an internal check of the new RUP value. It cannot be greater than the latest gross electrical power specified in Basic Information of the specification data module. Whenever the RUP is modified it is necessary to review and update values of the latest gross electrical power eventually the thermal power (if necessary) in Basic Information.

The RUP revision record can be removed by clicking on the Delete icon in the last column of the record. This action will restore the previous RUP values in the monthly records.

Clarifying notes:

(a) If a maximum power capability has been determined by formal test, the reference unit power is determined by correcting test results to reference ambient conditions. If a formal test has not been performed, the reference power should be based on design values, adjusted for reference ambient conditions.

(b) The reference unit power value should include the electrical equivalent of the portion of energy delivered in the form of steam/heat that might have been used for non-electrical applications. However, this applies only to the units, where the heat production may reduce the unit electrical power below its maximum value.

(c) The reference unit power is expected to remain constant unless design changes that affect the capacity are made to the unit or a new permanent authorization forces the plant management to amend the original value.

(d) Intentional plugging of steam generator tubes is considered a plant design modification. RUP should be re-evaluated and revised if necessary to account for the reduced maximum capability of the unit due to the intentionally plugged steam generator tubes.

5.1.2 Energy production

Annual information about electricity supplied to the grid and to non-electrical application systems during the reported year and lifetime generation by the end of the reported year.

Annual energy production:

Read-only information of sum of monthly net energy production in [$GW_e \cdot h$] as reported in the production data table for a reported year.

Electrical equivalent (net) of non-electrical energy generated (NEG):

This data item is shown and is applicable only to nuclear power units using a portion of their output energy in the form of heat/steam for non-electrical applications (desalination, district heating and process heat).

The electrical equivalent of energy supplied to "off-site" non-electrical application systems during the reporting period in the form of steam is expressed in gigawatts-hours (electric) [GW·h]. It is a sum of energy used for heat application systems:

- PDH for heat [Gcal] provided for district heating
- PPH for heat [Gcal] provided for process heat
- PDI for heat [Gcal] provided for desalination by sea water distillation
- PRO for electricity provided for desalination by reverse osmosis [MW·h]

The NEG electrical equivalent allows incorporation of this part of energy into statistics and indicators related to electricity production, like Load Factor including heat (LFH).

To convert the thermal energy in GCal into electrical energy in GW·h, the following factor may be applied: 1.16E-3 × (PDH+PPH+PDI) × 0.3 [GW·h/GCal],

where the factor 0.3 is used as a default value for an average thermal efficiency.

If desalination data contain Desalinated Water Volume DWV [m^3] but PDI is not provided, the following conversion factor to electrical energy (GW·h) may be applied: 2. 6E-5 × DWV. [$GW \cdot h/m^3$]

The total NEG [GW·h] may be expressed as:

NEG = 1.16E-3 × (PDH+PPH+PDI) × 0.3 + 2.6E-5 × DWV (if PDI=0) + 1E-3×PRO

WEDAS estimates NEG using the above formula. The calculated value is displayed in brown. The calculated value may be corrected by data providers considering the actual thermal efficiency of the plant. The corrected value is displayed in black.

Lifetime Cumulative Energy Generation (net):

Data entry for sum of net electricity generated (supplied to the grid) in [$GW_e \cdot h$] since the first connection of a reactor unit to the grid.

WEDAS checks the reported value against a sum of annual energy production in the current reporting year and lifetime electricity production reported for the previous year.

A decimal point (not comma) should be used in case of a decimal number.

Lifetime generation is verified in the consistency test VII (see 5.4.1).

5.1.3 Highlights of operation

Text information highlighting the main achievements and main events affecting operation of a reactor unit.

Highlights during the year:

Brief description of general performance and operational modes of the plant over the reporting period e.g. operation at full power in base load mode; load-following for a period; shut-down for a period; major achievements leading to increased availability;

Description of significant factors affecting energy generation over the reporting period, e.g. limitations introduced by regulatory bodies; limitations due to fuel management; shortage of consumables; personnel factors; equipment performance; environmental conditions.

5.1.4 Scram related numbers

Scram means the manual or automatic shutdown of the reactor by a rapid insertion of negative reactivity into the reactor core (e.g., by control rods, liquid injection shutdown system, etc.). This is caused by actuation of the reactor protection system, manual scram switches, and in certain cases described in the clarifying notes, manual turbine trip switches (or pushbuttons), provided in the main control room. The scram signal may have resulted from exceeding a set point or may have been spurious.

Data are collected for unplanned scrams that were not an anticipated part of planned tests. Scram related data are used on an annual basis for calculation of unplanned automatic and manual scram rates (UA7/US7).

The number of automatic and manual scrams is crosschecked with outage records coded as UF4/UF5/XF4/XF5 in the consistency test VIII (see 5.4.1).

Number of unplanned automatic scrams in the reporting period:

Data entry for a number of unplanned automatic scrams that occurred during the reporting period while the reactor was critical.

Automatic means that the initial signal that caused actuation of the reactor protection system logic was provided from one of the sensors monitoring plant parameters and conditions, rather than the manual scram switches or, in certain cases described in the clarifying notes, manual turbine trip switches (or pushbuttons) provided in the main control room.

Number of unplanned manual scrams in the reporting period:

Data entry for a number of unplanned manual scrams that occurred during the reporting period while the reactor was critical.

Manual means that initial signal that caused actuation of the reactor protection system logic, was provided from manual scram switches or, in certain cases described in the clarifying notes, manual turbine trip switches (or pushbuttons), provided in the main control room.

Number of critical hours in the reporting period:

Data entry for a number of hours during the reporting period when the reactor was critical.

Critical means that during the steady state condition of the reactor prior to the scram, the effective multiplication factor (k_{eff}) was essentially equal to one.

A decimal point (not comma) should be used in case of a decimal number.

Number of critical hours is reportable even if less than 1000. Nevertheless to be included in the industrial values, the reactor unit must have at least 1000 critical hours per year. Requiring this minimum number reduces the effect of reactor units that are shut down for long periods of time and whose limited data may not be statistically valid.

Clarifying notes:

(a) All unplanned reactor scrams must be reported, even if they occurred after the unit was disconnected from the grid (when the reactor remained at power and critical) and even if they occurred due to reasons considered not being under management control.
(b) Scrams that are planned to occur as part of a test (e.g., a reactor protection system actuation test), or scrams that are part of a normal operation or evolution and are covered by controlled procedures, are not included.
(c) Reactor protection system actuation signals that occur while all control rods are inserted are not counted because no control rod movement occurred as a result of the signals.
(d) During start up, shutdown, or changing power condition, the reactivity transients may cause the reactor to go subcritical or super-critical for a short period of time. However, the plant is considered critical for purposes of this reporting if the reactor was critical prior to the reactivity transient and may be assumed to return to a critical condition after the transient is completed (e.g. a plant is considered to remain critical after initial criticality is declared on a reactor start up and to be critical until taken permanently subcritical on a reactor shutdown).
(e) Each scram caused by intentional manual tripping of the turbine should be analysed to determine those which clearly involve a conscious decision by the operator to manually trip the turbine to protect important equipment or to minimize the effects of a transient. Scrams that involve such decisions are considered manual scrams.
(f) Practical examples of reactor protection system actuations:
    - While shutting down the reactor, sufficient control rods had been inserted to make the reactor subcritical. A spurious scram signal then caused the remaining control rods to insert into the core. This scram is not reportable because the reactor was not critical;

- A reactor scram occurred while conducting a special test on the turbine. The plant procedure used for this test indicated that a scram would occur while performing the test. This scram is not reportable because the scram is part of a planned operation and is covered by plant procedures;
- While conducting a routine surveillance test of the reactor protection system at 100 % power, a reactor scram occurred when a spurious signal was received on one protection system channel while another channel was being tested. This scram is reportable as an unplanned automatic scram;
- While at full power, a main feed-water pump tripped. Operators attempted to restart the pump and to reduce reactor power, but actions to maintain steam generator (PWR) or reactor (BWR) levels were unsuccessful. Operators then initiated a manual reactor scram before the set point for an automatic scram was reached. This scram is not reportable as an automatic scram because it did not result from an automatic actuation of the reactor protection system, but is reportable as an unplanned manual scram;
- While at 75 % power, operators tripped the main turbine to prevent over-speed caused by a malfunction in the turbine control system. The turbine trip caused an automatic reactor scram. This scram is reportable as an unplanned manual scram because the scram was caused by operators manually tripping the turbine to prevent equipment damage.

5.1.5 Operating Cycle Information:

These data items are applicable and shown only for PWR and BWR reactors with off-line refuelling.

Operating cycle (OC) in PRIS is a period from the start up after refuelling to the start up after the next refuelling. The first cycle is from first grid connection to the start up after the first refuelling outage. Check the box if new operating fuel cycle started in the reporting year.

Operating cycle data are introduced by information about the previous operating cycle.

Operating cycle data are used for calculation of performance indicators for OC periods and for statistics on duration of operating cycles and refuelling outages.

Marking the check box next to the label **Actual Operating Cycle** opens the data field for the actual reporting year.

Cycle number:

The sequence number of an operating cycle that started in the reporting year. The first cycle from the first grid connection has number 1.

WEDAS automatically assigns the number based on the previous record. The number can be manually corrected, if necessary. In this case numbers of previous records should also be rectified.

Cycle Start date:

Read-only information transferred from the previous cycle record. Cycle Start date is identical with Operating Cycle End Date as specified for the previous cycle. If previous cycle is not specified, the information is not used.

Refuelling Start date (Grid disconnection for refuelling):

Data entry for a date and time of grid disconnection for refuelling outage which is part of the reported operating cycle.

Operating Cycle and Refuelling End date (Grid reconnection after refuelling):

Data entry for a date and time of grid reconnection after a refuelling outage which is part of the current operating cycle. When the refuelling outage is not finished by the end of the reported year and is not known in a time of data reporting, leave this data field empty. It can be completed in the next year reporting.

5.2 PRODUCTION DATA

Monthly production data consists of two parts: electricity production and unavailability data. Reference Unit Power is an integral part of each monthly record, which is controlled through the RUP revision on the Operating Experience data screen.

Production data are expected to be provided monthly during the year. Reporting monthly records annually is also possible but in this case PRIS end-users cannot benefit from performance monitoring in a current year.

5.2.1 Electricity production and on-line hours

Electricity production and on-line hours data are used for calculating several PRIS statistics, especially Electricity Generation (EG), Operation Factor (OF) and Load Factor (LF).

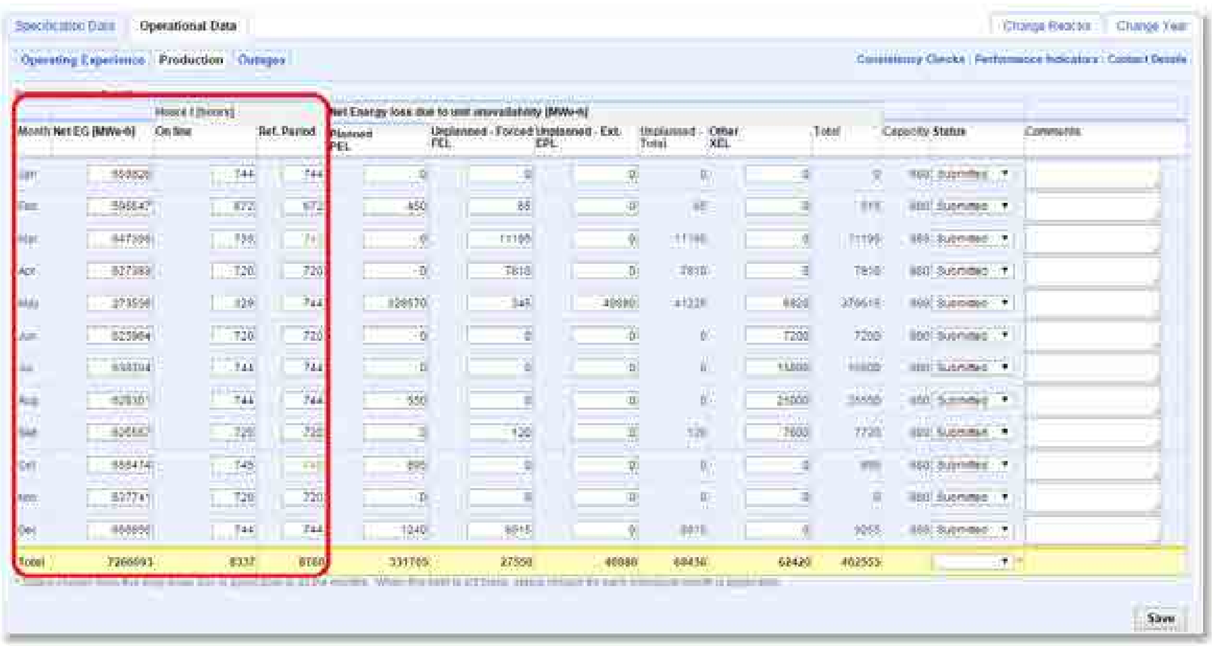


FIG. 5-2: Monthly production data table

Energy Generated (net), EG:

Data entry for monthly net electrical energy in [MW(e) ·h] supplied during the month to the grid as measured at the unit outlet terminals, i.e. after deducting the electrical energy taken by unit auxiliaries and the losses in transformers that are considered integral parts of the unit.

Values over the maximum production capacity (Reference Energy Generation minus losses) are indicated in WEDAS by brown framing the data field and providing a message when the cursor is moved over the data field. The value can be saved and system will indicate it as an overproduction. Please, check correctness of the entered value in such a case.

The energy generated is the energy supplied to the grid and not the balance of the energy considering energy import from the grid. In some months the reactor unit can have a negative balance of energy. WEDAS allows entering negative values but the correct value is the energy which was supplied to the grid without its reduction by energy imported from the grid.

EG values are crosschecked in the consistency test II for energy balance (see 5.4.1).

On-line Hours, t:

Data entry for total clock hours in the month during which the unit operated with at least one main generator connected to the grid.

The number cannot be greater than the reference period hours. In case of daylight saving it is necessary to modify the reference period hours first.

On-line hours are crosschecked with outage records in the consistency test I (see 5.4.1).

Reference Period, T:

Generally, data entry for a total number of hours in the whole calendar month.

For units being commissioned during the month, the clock hours from the first connection to the grid to the end of the month.

For units being in operation at the beginning of the month, the clock hours from the beginning of the month to the end of the month or to the final disconnection from the grid, whichever comes first.

WEDAS provides a possibility to adapt reference hours to daylight saving time. It is possible to modify reference hours by ±1 hour by overwriting predefined hours. This modification should be confirmed by checking the box 'Update reference hours' (above the Save button).

Multiplication of reference period hours by RUP determines REG.

5.2.2 Unavailability data

For the purpose of the PRIS, the unit unavailability is defined as a status of power plant unit, when it is not able to operate at its reference power for technical or environmental reasons. This condition, which may be under or beyond plant management control, reflects only lack of readiness of the unit for the grid. It does not include situations, when a power plant unit was operated at a reduced power, while it would be able to operate at the reference unit power (for example due to low energy demand, transmission grid failures or unfavourable political situation in the country).

It follows from the above definition that unit operation at reduced power does not always imply unit unavailability. In other words, a unit may be operated at a reduced power, even though it is fully available. In the Unit Unavailability Data table, only those energy losses, which have been caused by power plant unit unavailability as defined above, should be entered.

Three types of energy losses caused by unit unavailability have been defined and are reportable in the unavailability data table of PRIS: planned energy loss (PEL), unplanned energy loss (FEL, EPL), both due to causes controllable by the plant management, and externally caused energy loss (XEL), which is due to constraints beyond the plant management control.

Energy losses due to reasons like a grid failure, load following operation, or government/court decisions, when the unit was fully available (capable of reaching the reference unit power) are not reportable in the unavailability data table. For completeness of information on energy loss due to those reasons, however, the energy losses with the unit fully available should be reported in the Outage Data module (see the outage cause codes (I), (J), (K), (M), (O) and (U) in the Chapter 6.

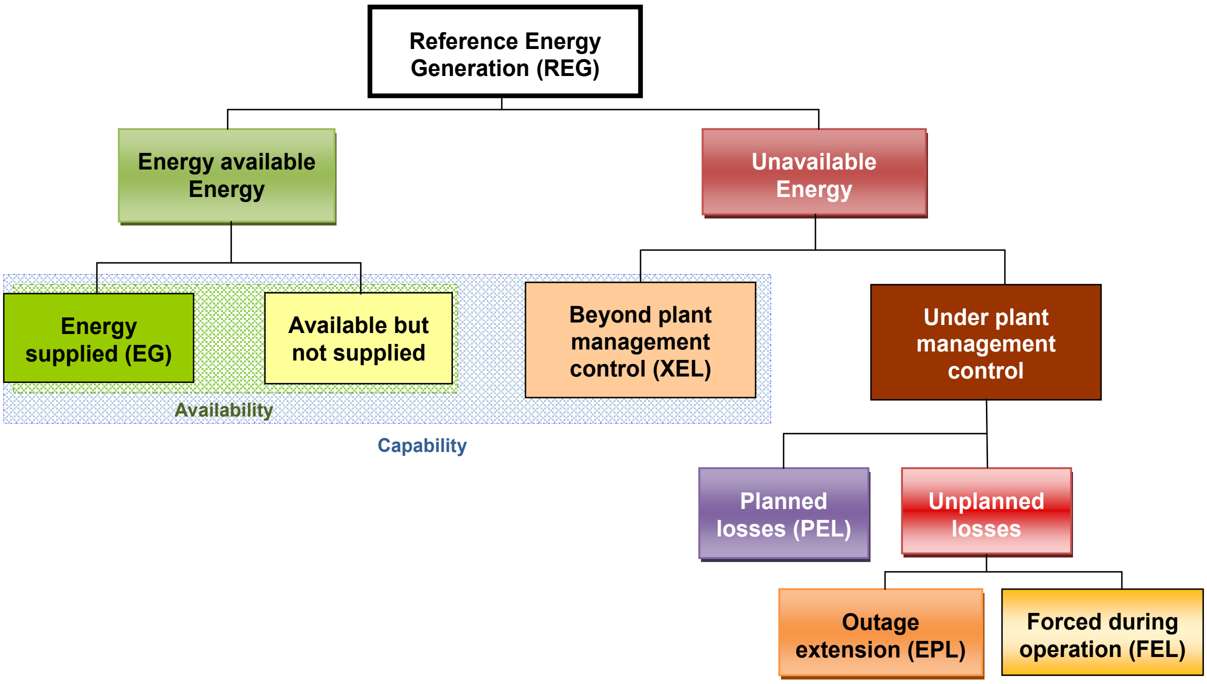


FIG. 5-3: Data model for production and unavailability data

The energy loss due to reduced power is always related to the Reference Unit Power. The values of power losses to be used in computing energy losses due to a particular event are the losses that would have occurred if the unit were operating at the reference power level at the time of the event. Figure 5-4 shows principles for calculation. The power losses relative to the reference unit power may be determined by one of the following techniques:

- Subtracting the actual power level during the event from the power level immediately prior to the event when the power was at or near the reference power level;
- Computing the power level reduction that would have occurred with the unit at the reference power level;
- Using historical data from similar events occurring at the reference power level.

For example, if a unit experiences a 10 MW power loss due to an equipment problem while operating at 75% of the reference power, and it is determined from calculations or from similar events that have occurred at the reference power that the same equipment problem would have resulted in a 20 MW power loss at the reference power level, then 20 MW should be used when computing the energy loss.

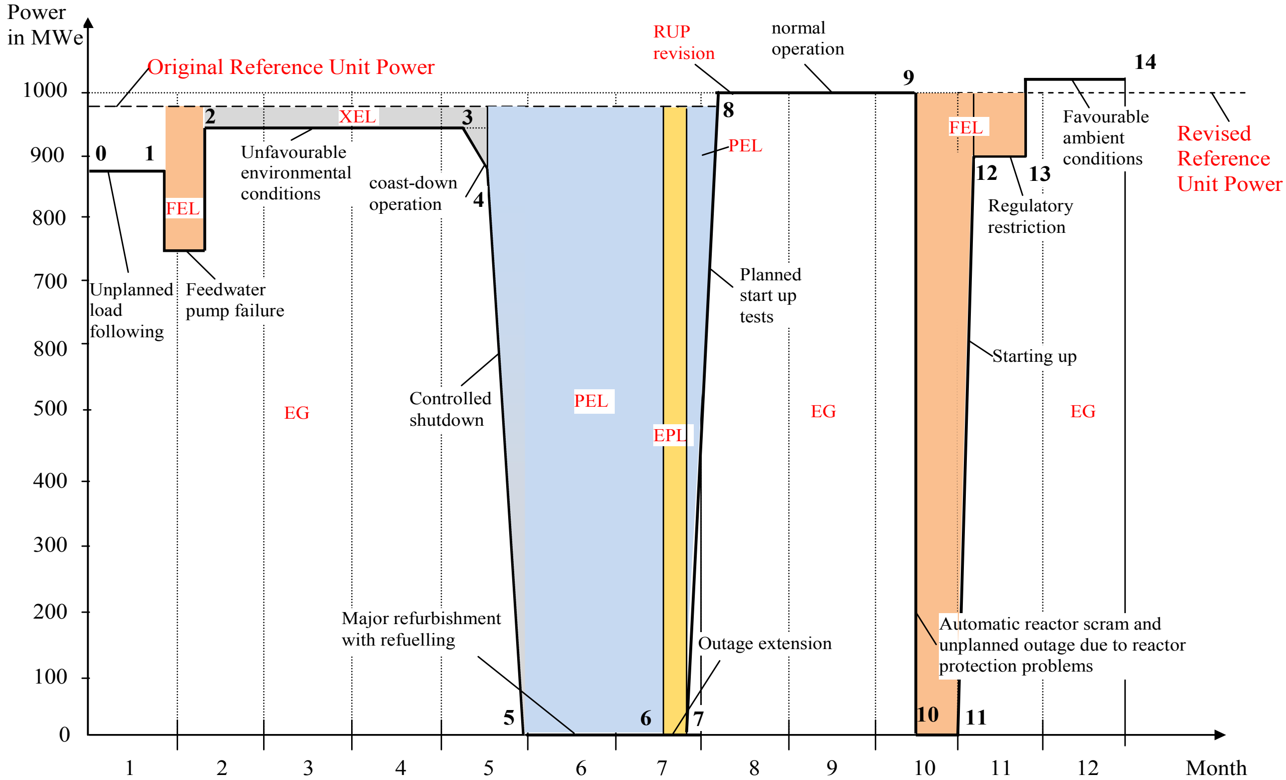
Energy losses related to load reduction preceding a shutdown and load increases following the shutdown should be categorized as planned or unplanned depending on whether the shutdown is planned or unplanned. For example, energy losses while entering and recovering from a planned outage will be considered as planned losses. If an outage extension (unplanned outage) occurs at the end of a planned outage, the energy loss during recovery from the outage will still be considered as a planned loss because the shutdown was originally caused by a planned outage (see Figure 5-4, time period 5-6 as an example of this situation).

Energy losses for unrelated but concurrent causes that result in generation losses are determined and reportable as if the energy losses occurred separately. However, total losses in a month cannot exceed REG with priority given to unplanned energy losses during operation. Special cases of concurrent losses are discussed in clarifying notes.

If energy losses during an event occur due to a combination of causes under management control and causes beyond the plant management control, the related portions should be identified and included when computing reportable losses.

A unit in reserve shutdown should be considered as available if it can be restarted within the normal time required for unit start up. However, if work on plant equipment is undertaken that would prevent a restart, the energy that potentially could have been produced while the plant was unavailable should be computed and reported as planned or unplanned energy loss, even if the plant was not actually required to start-up during the period.

Unavailability data are used for calculating several statistics on a monthly and annual basis, explicitly the following nuclear power plant performance indicators: Energy Availability Factor (EAF), Planned Energy Unavailability Factor (PUF), Unplanned Energy Unavailability Factor (UUF), Unit Capability Factor (UCF), Unplanned Capability Loss Factor (UCL), Forced Loss Rate (FLR)



Section	Description
0 – 1	Load following operation
1 – 2	Power reduction due to a feed water pump failure (protection actuation ⇒ immediate controlled reactor power reduction) (FEL)
2 – 3	Reduced power operation due to unfavourable ambient conditions (XEL)
3 – 4	Coast-down operation (XEL)
4 – 5	Unit shutdown for a planned refuelling and major refurbishment (PEL)
5	Reactor off-line and subcritical
5 – 6	Refuelling with a major turbine refurbishment focused on power up rate (PEL)
6 – 7	Unplanned extension of the outage due to a reactor flange leak (EPL)
7	Reactor critical
7 – 8	Unit connected to the grid, planned start-up tests (PEL)
8	Revision of the Reference Unit Power (RUP increase)
8 – 9	Normal operation at the increased reference unit power
9 – 10	Automatic reactor scram due to a reactor protection system failure (FEL)
10 – 11	Unplanned outage to identify and solve the RPS problem (FEL)
11	Reactor critical
11 – 12	Unit connected to the grid, start-up from the unplanned outage (FEL)
12 – 13	Reduced power due to regulatory restriction - RPS reliability verification (FEL)
13 – 14	Increased power operation due to favourable environmental conditions

FIG. 5-4: Example of power history and classification of energy loss.

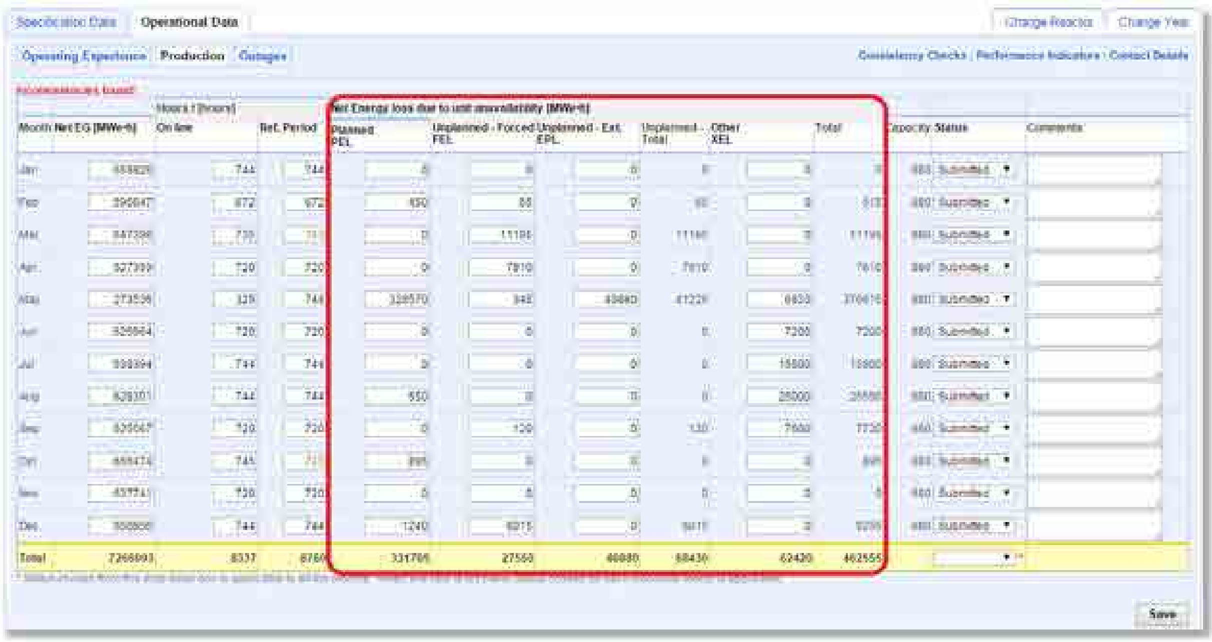


FIG. 5-5: Unavailability data table

WEDAS includes internal checks protecting against saving entered values that do not meet the following criteria:

- Sum of energy losses for a month should not be greater than reference energy generation (REG);
- Electricity generated (EG) plus sum of energy losses (EL) should be less than REG increased by 10% of possible overproduction. Formula used: $EG+\Sigma EL<REG+0.1EG$. This criterion checks energy balance and limits overproduction to 10% of an actual EG.

By yellow framing, the system points out a possible mistake but is ready to accept the value. Red framing of the data field indicates not acceptable values. WEDAS also provides additional information when a cursor is moved over the highlighted data field.

Planned Energy Losses (net), PEL:

Data entry for energy, expressed in electric megawatt-hours [MW(e) ·h], that was not delivered during the month because of planned shutdowns or planned load reductions due to causes under the plant management control.

Energy losses are considered to be planned if they are scheduled at least four weeks in advance. The planned energy loss is determined by planned start date and duration of a planned outage.

Energy losses considered to be under plant management control are explained in the clarifying notes.

Planned energy losses are crosschecked with outage records in the consistency test IV (see 5.4.1).

Clarifying notes:

(a) Planned energy losses caused by the following conditions are considered to be under the control of plant management:
  - refuelling or planned maintenance outages
  - planned outages or load reductions for testing, repair, or other plant equipment or personnel-related causes

(b) Energy losses due to tests may be considered as planned if they are identified at least four weeks in advance and are part of a regular programme, even if the precise time of the test is not decided four weeks in advance.

(c) The scheduled start and end dates of planned outages and load reductions are those dates negotiated with and agreed to by the network and/or grid dispatcher at least four weeks in advance. These dates may differ from dates shown on the detailed schedule of activities used at the unit for directing the outage.

(d) In general, any change in the planned outage start date is considered unplanned, unless it is announced at least four weeks in advance. The following rules should be applied for unplanned changes:
  - If a unit begins an outage or load reduction before the scheduled start date (unplanned change), the energy loss from the beginning of the outage or load reduction to the scheduled start date is an unplanned forced energy loss.
  - If the start date is postponed, the outage is still considered planned only until the originally scheduled completion date.

(e) Energy losses due to required tests following refuelling are considered planned losses.

(f) In general, changes in a planned outage or load reduction start date must be announced at least four weeks in advance to be considered as "planned." However, if the grid dispatcher requests a change in the start date less than four weeks in advance, the outage or load reduction is considered to be planned, assuming this decision is due to all of the following reasons or circumstances:
  - The unit is considered as able to run at maximum power during the four-week period prior to the initial planned outage start date;
  - Any forced or unplanned outage occurring during this four-week period (or before the new start date) shall not become the reason for putting forward the planned outage.

Unplanned Energy Losses (net): UEL

The energy, expressed in electric megawatt-hours [MW(e) ·h], which was not delivered during the month because of unplanned shutdowns, unplanned load reductions or outage extensions due to causes under the plant management control.

The shutdowns or load reductions due to causes under plant management control are considered unplanned, if they are not scheduled at least four weeks in advance. Unplanned energy loss is reported in two categories:

- Forced energy loss during operation;
- Unplanned extension of planned outages.

Unplanned energy loss is a sum of the above data items and is shown as read-only information. It is crosschecked with outage records in the consistency test III (see 5.4.1).

Forced energy losses, FEL:

Data entry for energy, expressed in electric megawatt-hours [MW(e) ·h], that was not delivered during the month because of unplanned shutdowns or unplanned load reductions that happened during operation due to causes under the plant management control.

Extensions of planned energy losses, EPL:

Data entry for energy, expressed in electric megawatt-hours [MW(e)·h], that was not delivered during the month due to unplanned extensions of planned shutdowns or load reductions beyond the original planned end date when originally scheduled work was not completed, or new work was added to the outage less than 4 weeks before the scheduled end date, if causes were under the plant management control.

Clarifying notes for both categories of unplanned losses:

(a) Unplanned energy losses resulting from the following conditions are considered to be under the control of plant management:
- unplanned maintenance outages (FEL);
- unplanned outages or load reductions for testing, repair, or other plant equipment or personnel-related causes (FEL);
- unplanned outage extensions (EPL);
- unplanned outages or load reductions that are caused by, or prolonged by, regulatory actions taken as a result of plant equipment or personnel performance. This also relates to regulatory actions applied on a generic basis to all like plants (FEL/EPL).

(b) Unplanned energy losses due to the following causes should not be reported as FEL or EPL because these losses are not considered to be under the control of the plant management:
- grid instability or failure;
- lack of demand (reserve shutdown, economic shutdown, or load-following);
- environmental limitations (for example low cooling pond level, water intake restrictions, earthquakes, tsunami or deluges that could not be prevented by operator action);
- industrial action (labour strikes) - see clarifying note below;
- fuel coast downs;
- seasonal restriction to achievable power due to variations of cooling water parameters (temperature, salinity).

(c) In general the generation losses that were not planned and scheduled 4 weeks in advance - as is the case with typical equipment or personnel-caused losses - are unplanned, and remain as such until the cause of the unplanned losses is not fixed. The fact that management "knows" or "is aware" the losses will continue beyond the 4 weeks, does not make the losses (or cause of the losses) "planned".

(d) In case of generation losses due to equipment degradation (heat exchanges, valve steam leaks, etc.) the energy losses would be reported as unplanned forced until the degradation (cause of the unplanned losses) is repaired or the unit enters a planned outage scheduled before the cause of the unplanned loss.

(e) If the equipment problem cannot be fixed immediately and requires a temporary design change (for example, isolation of the failed component) which reduces the power for months until the final repair is done, the related power loss (for the whole period of reduced power) should be classified as unplanned until all corrective maintenance required for operation at full power operation is completed.

(f) Energy losses associated with failed fuel are considered the same as a loss associated with an equipment failure. Continuous de-rated operation due to the presence of failed fuel is classified as unplanned until the unit is shut down for refuelling.

(g) If a unit begins an outage or load reduction before the scheduled start date, the energy loss from the beginning of the outage or load reduction to the scheduled start date is an unplanned forced energy loss (FEL).

(h) Special cases of concurrent losses when the reactor unit is shut down:

- A loss cannot be classified as planned and scheduled to correct causes of unplanned losses after the unplanned losses begin. However, when causes of unplanned losses continue after the scheduled start date of already planned and scheduled shutdown, the unplanned losses are not reported during the planned shutdown period. The reported losses are unplanned (FEL/EPL) for the period before the planned outage and planned (PEL) for the period of the scheduled shutdown.
- If unplanned losses continue even after the scheduled end date of the planned shutdown, the unplanned losses are either:
  - *Outage extension losses* if repair of that cause is required for startup, or work planned and scheduled during the planned period was not completed as planned and scheduled.
  - *Unplanned forced losses,* if the cause existed prior to the planned outage and was not repaired by its end and not needed for startup.

(i) If an outage extends beyond the scheduled start-up date, either to complete originally scheduled work or to complete corrective maintenance work on equipment required for start-up, all energy losses associated with the outage extension should be considered as unplanned outage extension loss (EPL), not forced. However, outage extensions to complete discretionary work (i.e., preventive maintenance or modifications) not originally scheduled for completion during the outage should be considered as planned if the work is scheduled at least four weeks before the extension began.

Other (externally caused) Energy Losses (net), XEL:

Data entry for energy, expressed in electric megawatt-hours [MW(e) ·h], that was not delivered during the month due to constraints reducing plant availability and being beyond the plant management control.

Externally caused energy losses are crosschecked with outage records in the consistency test V (see 5.4.1).

Clarifying notes:

(a) Energy losses caused by the following conditions should be reported as XEL:
- Environmental conditions (seasonal variations in cooling water temperature, flood, storm, lightning, lack of cooling water due to drought, tidal valves, high sea or water intake restrictions that could not be prevented by operator action);
- Fuel coast-down (power reduction at the end of fuel cycle resulting in release of a positive reactivity to compensate for high fuel burn-up);
- Restrictions on supply and services due to external constraints (lack of funds due to delayed payments from customers, disputes in fuel industries, fuel-rationing, spare part procurement difficulties etc.);
- Heat supply to non-electrical applications;
- Shutdowns, load reductions and outage extensions caused by labour strikes.

(b) Energy losses due to the following causes should not be reported as XEL (but should be reported in outage records) as these losses are not related to plant unavailability:
- Grid instability, grid failure or grid unavailability;
- Lack of demand (load-following, frequency control, reserve shutdown, economic shutdown or losses due to reactive power demand from the grid);
- A unit that is in reserve shutdown should be considered as available if it can be restarted within the normal time required for unit start-up;
- Security and access control and other preventive shutdown due to external threats;
- Governmental requirements or court decisions.

(c) The unit which is damaged by earthquake or other external events when being in a planned shutdown continues reporting planned generation losses until the scheduled end date for the original outage. After that, the losses should be reported as XEL in monthly records and as an externally caused outage extension (XF3) in outage records until start-up.

(d) If a unit was operating and scrammed as a result of an environmental event (for instance earthquake or storm), the scram should be reported and subsequent energy losses due to damage caused by the event are reportable as XEL. This assumes that the plant equipment was not expected to be capable of mitigating the external event. If the plant equipment was designed to have prevented damage from the size of the event, the losses would be unplanned losses (FEL).

(e) When a unit supplied reduced electricity to the grid due to electricity/steam supply to the neighbouring unit of the same plant the related energy losses are reportable as XEL. An internal extraction of energy does not affect unit capability but the unit is not fully available for the grid.

(f) When a unit supplied reduced electricity to the grid due to steam supply to a non-electrical application unit (on-site desalination and off-site heat distribution), the related energy losses are reportable as XEL.

(g) Energy losses due to labour strikes are not considered to be under the plant management control and are reportable as externally caused losses (XEL).

- If a labour strike occurs during plant operation, any shutdown or load reduction, generation losses during the strike are reportable as externally caused losses;
- If the strike occurs during an unplanned / forced outage, reportable unplanned losses resume after the strike is over.
- If the strike occurs during a planned and scheduled outage, the original scheduled end date of the planned outage is considered to have been extended by the duration of the strike. The revised scheduled end date is used to determine planned losses and outage extension losses once the strike is over.

Energy losses due to labour strikes during a planned outage are reportable as externally caused energy losses (XEL) in monthly records and related outage records are coded as externally caused outage extension (XF3).

5.3 OUTAGES

For the purpose of PRIS coding, the outage is the status of a reactor unit when its actual output power is lower than the reference unit power for a certain period. The outage includes both power reduction and unit shutdown, however it is recognised that in a common understanding outage means the shutdown only.

The outage records support analyses of energy losses according to their character, causes, frequency and analyses of system reliability. The outage record consists of start date and duration, related energy loss, codes for type and cause of the outage and the system involved, operating mode and outage description. For details about PRIS outage coding see the references [1] and [2].

New outage record is created by clicking the button ‘Add’ on the outage record landing screen – see Figure below. WEDAS uses internal numbering of outages.

It is desirable to report all power reductions in outage records. As a minimum all significant outages including outage extensions and reactor scrams should be reported. The outage is considered significant, if the loss in the energy production corresponds to at least ten hours of continuous operation at the reference unit power or if it has been caused by an unplanned reactor scram (even if the unit had been shut down for less than 10 hours).

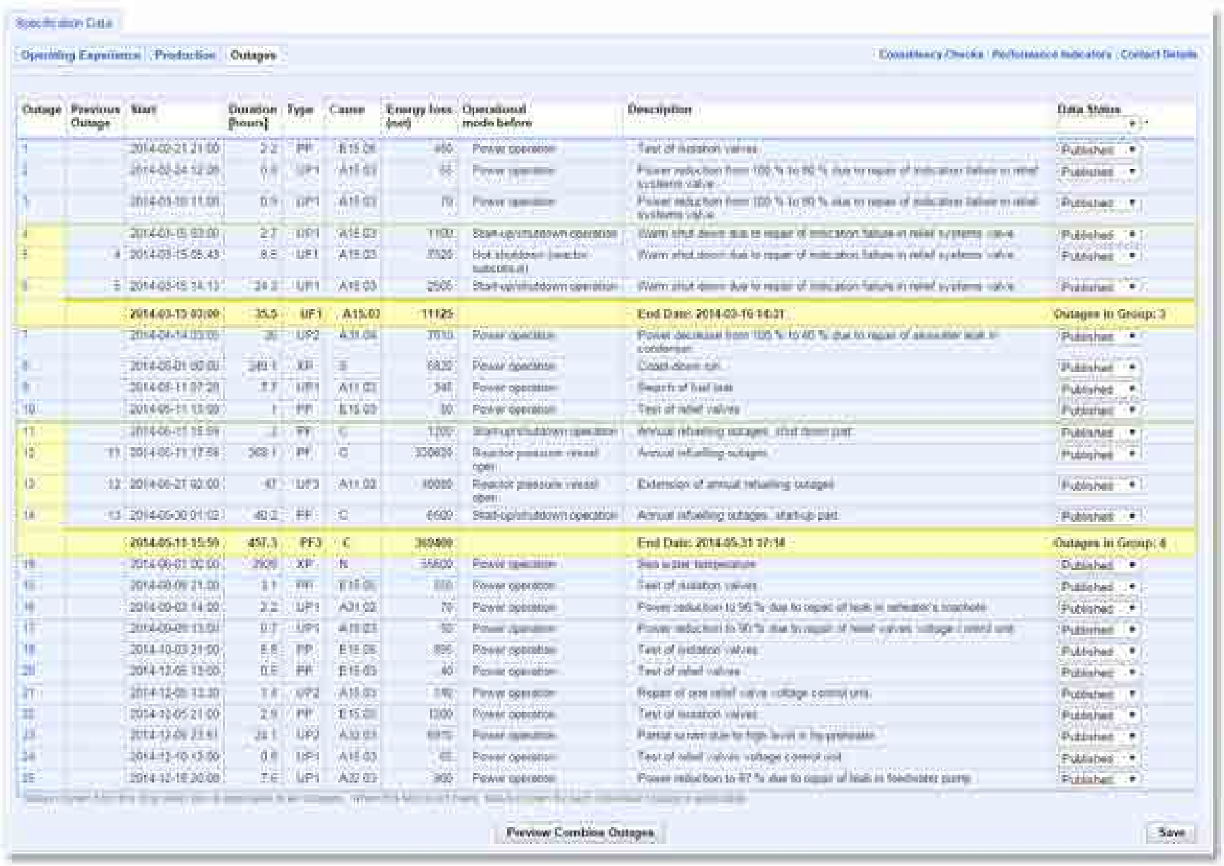


FIG.5-6. Screen of outage records

WEDAS is ready for reporting outages in fragments, as the duration of some outages is longer than the reporting period (month) or an outage course is a combination of various types and causes. Fragments belonging to one outage should be combined into one logical ensemble allowing it to be analysed as one occurrence (combined outage). WEDAS supports outage fragment combination by a special function ‘Preview Combine Outages’.

Clarifying notes:

(a) If more outages occurred at a time, they would be considered as separate outages and reported as if the unit was operating at the reference power;

(b) The reactor scram is defined as a reactor shutdown achieved by rapid insertion of negative reactivity into the reactor core, which can be performed either manually or automatically. All unplanned reactor scrams must be reported, even if they occurred after the unit was disconnected from grid (when the reactor remained at power). Planned scrams performed as a part of planned tests are not reported;

(c) The outage extension is a prolongation of the planned outage beyond its originally planned completion date. Outage extension must be reported as unplanned in a separate outage record. However when outage extension is announced at least four weeks in advance it is considered a part of the planned outages and is not reported separately as unplanned extension.

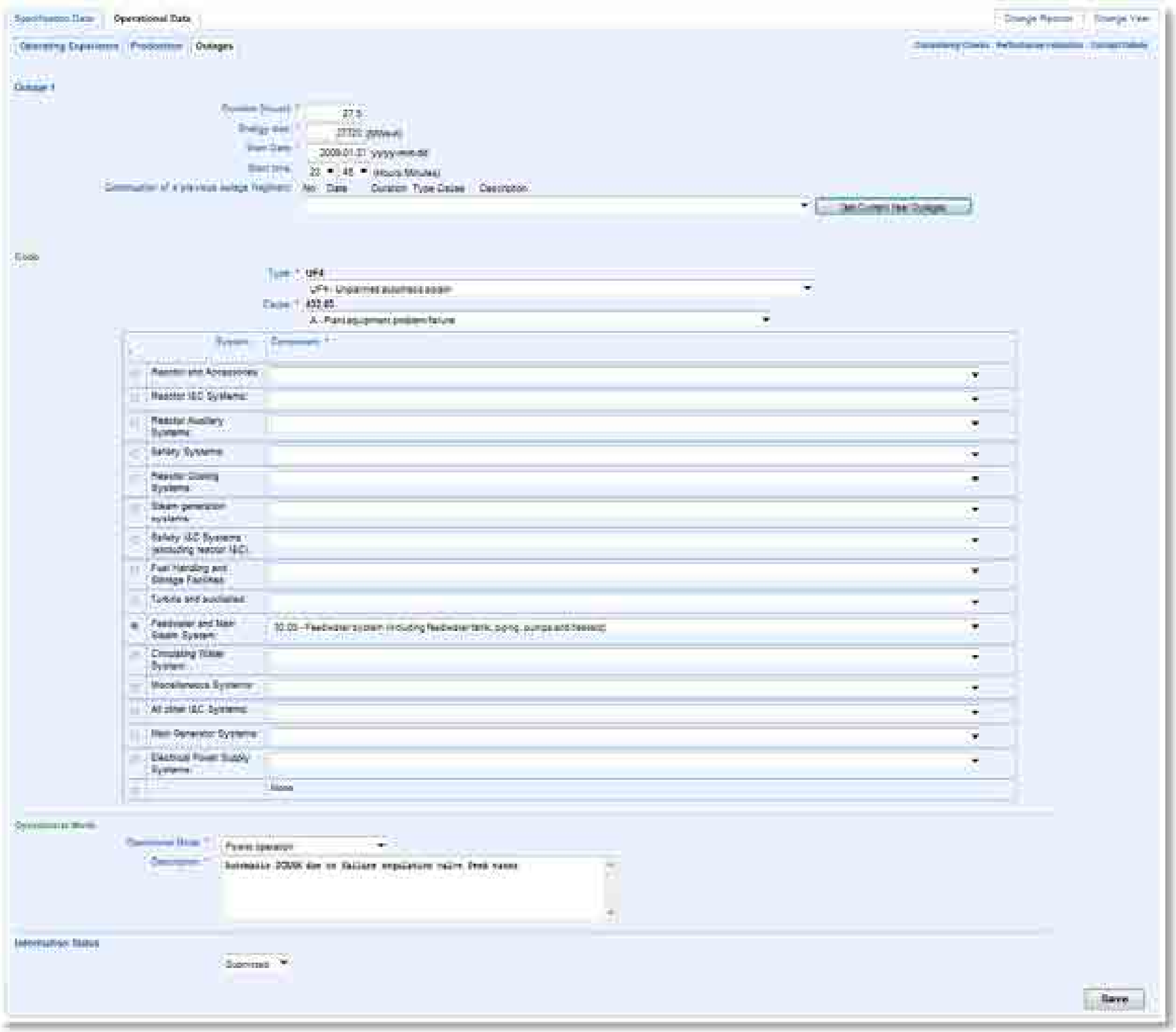


FIG. 5-7: Outage data screen

Data elements in an outage record

Outage duration:

Data entry for total time of the outage measured in hours from the beginning of the reporting period or the outage, whichever comes last, to the end of the reporting period or the outage, whichever comes first.

Clarifying notes:

(a) If a part of the outage extends to the next reporting period, the corresponding outage duration is coded for each reporting period separately. All outage fragments of the same outage should be linked into one ‘combined outage’.

(b) If an outage record is not fragmented and includes both the power decrease and power rise periods before and after a full outage period, the time should include also those parts.

(c) The outage duration cannot be zero (0) and the field cannot be left blank.

(d) For reactor scram after disconnection of the unit from the grid (energy loss is zero), at least a minimum duration (0.01 hour) should be reported.

(e) For intermittent outages (e.g. due to load following operation), enter cumulative data for the reporting period.
(f) Outage duration cannot make the outage end into the next year reporting period.

Energy Loss (net):

Data entry for total energy expressed in electric megawatt-hours (MW(e) ·h) that has not been delivered to the grid or other consumers due to the outage.

Energy loss for full outages is crosschecked with calculation based on outage duration in the consistency test VI (see 5.4.1).

Clarifying notes:

(a) The calculation of energy losses due to reduced power is always related to the Reference Unit Power – see rules in 5.2.2.
(b) Energy losses are calculated separately for each outage. If several outages are concurrent in a period of time, energy loss for each outage is reported as if the unit was operated at the reference power at the beginning of the outage.
(c) The field cannot be left blank.
(d) For reactor scrams after disconnection of the unit from the grid, zero (0) energy loss is reported.
(e) For intermittent outages (e.g. due to load following operation), enter cumulative data for the reporting period.

Start Date:

Data entry for a date of the first day of the outage in the form of 'YYYY-MM-DD'

For instance: 2013-12-28 for 28 December 2013.

Clarifying notes:

(a) If no start date can be specified (e.g. for a continuous load following operation), enter the first day of the reporting period.
(b) If an outage continues from the previous reporting period, enter the first day of the reporting period.
(c) The field cannot be left blank.
(d) For reporting outages in fragments the start date (and time) should be the same as the end of a previous outage fragment. A maximum tolerance is 24 hours.

Start Time:

The time of outage beginning is specified by selection of hours and minutes.

Default selection is 00:00.

Continuation of a previous outage fragment:

Manual setting of outage fragment links.

Selection from the dropdown list assigns an outage record which is preceding part/fragment of the same outage.

This assignment creates a logical link between those two parts only when the following rules are fulfilled:

- Time concurrence – end of a preceding part is consistent with the beginning of this outage record;
- The first character of the Type Code (P, U, X for Planned, Unplanned and External) is the same. The only exception is unplanned extension of planned outage (UF3, UP3, XF3 and XP3). These fragments can be combined with preceding planned (P) outage fragments;
- For the third character of the Type Code it is not allowed to combine codes 1, 4 and 5;
- The Cause Code of combined unplanned (U) or external (X) fragments should be the same (except when planned outage is combined with unplanned extension). The code E for planned outages (P) can be combined with cause codes B, C, D, F, G when E code is used for fragments related to testing of plant systems or components at the end of planned outages – usually start-up period after an outage;
- If system code is used, all fragments should have the same system code. If the system code is specified at least in one fragment and is not specified for other fragments then the combined outage has this fragment system code.

To link an outage record with other record reported in a previous year the function 'Get Previous Year Outages' should be used.

Type code:

Selection of a two- or three-character code for the outage type from the dropdown list.

Clarifying notes:

(a) The type code consists of three partial codes (characters).

First character:

P: Planned outage due to causes under the plant management control

U: Unplanned outage due to causes under the plant management control

X: Outage due to causes beyond the plant management control ("external")

- Criteria for first character categorisation are in Chapter 5.2.2. For outages under the plant management control the key criterion is if the outage was scheduled at least four weeks in advance;
- 'External' outages may be also considered planned or unplanned. Although this aspect is not explicitly coded, adding the third character (see below) to the 'external' outage code will imply the unplanned 'external' outage;

- The unplanned extension of planned outages due to changes in outage start date should be coded as a separate outage.

Second character:

F: Full outage

P: Partial outage

- An outage is considered full if the actual unit output power has been reduced to zero percent- unit disconnected from all off-site power supply lines;
- An outage is considered partial if the actual unit output power is lower than its reference value, but the reactor unit is still connected to the grid.

Third character:

1: Controlled shutdown or load reduction that could be deferred but had to be performed earlier than four weeks after the cause occurred or before the next refuelling outage, whatever comes first

2: Controlled shutdown or load reduction that had to be performed in the next 24 hours after the cause occurred

3: Extension of planned outage

4: Automatic reactor scram

5: Manual reactor scram

- Third character is applicable to unplanned outages;
- The third character should be assigned also to outages due to causes beyond plant management control ("external"), which can be considered unplanned (see the cause codes J, M, N, R, T and U below).

(b) The outage type may have one of the following codes:

PF	or	PP
UF1-5	or	UP1-3
XF	or	XP
XF1-5	or	XP1-3

Direct Cause code:

Selection of a cause code for the outage from the dropdown list.

Clarifying notes:

(a) The code represents a direct cause of the outage.
The direct cause is defined as an immediate action or condition that has directly resulted in the outage.
For example, if a minor equipment failure, such as an oil leak dropping on a hot pipeline or a short-circuit in a non-vital switchgear cabinet, results in an extensive

fire that directly causes an outage, the fire is considered the direct cause of the outage.

(b) For a particular outage (full or partial), only one cause may be selected. If two or more causes were involved in the outage, select the most significant.

(c) If outages occur successively, they must be reported as separate outages due to different causes.

For example, if unit power was first reduced due to an equipment failure, but the unit subsequently tripped due to a human error when responding to the failure, these incidents should be reported as two separate outages caused by equipment failure and human factor respectively. Similarly, partial and full outage following immediately one after the other and having the same direct cause must be reported separately.

(d) The direct cause code consists of following codes:

A: Plant equipment failure
B: Refuelling without a maintenance
C: Inspection, maintenance or repair combined with refuelling
D: Inspection, maintenance or repair without refuelling
E: Testing of plant systems or components
F: Major back-fitting, refurbishment or upgrading activities with refuelling
G: Major back-fitting, refurbishment or upgrading activities without refuelling
H: Nuclear regulatory requirements
I: Grid limitation (a new cause code in the PRIS coding system)
J: Grid failure or grid instability
K: Load-following (frequency control, reserve shutdown due to reduced energy demand, losses due to reactive power demand from the grid)
L: Human factor related
M: Governmental requirements or Court decisions
N: Environmental conditions (flood, storm, lightning, lack of cooling water due to dry weather, cooling water temperature limits etc.)
O: Load dispatching, prioritization (a new cause code in the PRIS coding system)
P: Fire
R: External restrictions on supply and services (labour strikes, lack of funds due to delayed payments from customers, disputes in fuel industries, fuel-rationing outside the plant, spare part delivery problems etc.)
S: Fuel management limitation (including high flux tilt; stretch out operation to extend an operating cycle or coast-down operation due to fuel burn up)
T: Heat supply (on site to support next unit or desalination and off-site heat distribution)
U: Security and access control and other preventive shutdown due to external threats.
Z: Others

(e) Planned outages may be due to causes coded B, C, D, E, F, G

(f) Unplanned outages may be due to causes coded A, H, L, P

(g) External outages may be due to causes coded I, J, K, M, N, O, R, T and U. Energy losses coded as I, J, K, O, M, U are not reportable as externally caused unavailability (XEL) but are reportable in outage records.

(h) The cause coded S can apply to planned (stretch out operation), unplanned (high flux tilt) and external outages (coast down operation).

(i) The cause coded T can apply to planned, unplanned (to support a next unit) and external outages (on-site desalination and off-site heat distribution).
(j) Causes related to equipment (A), repair (D), testing (E), back-fitting (F, G), nuclear regulatory requirements (H), human actions (L), environmental conditions (N), fire (P), fuel management (S) and other (Z) should, whenever applicable, be followed by the code of the plant system affected by or otherwise involved in the outage.
(k) The cause code J which was originally assigned to energy losses related to grid limitation and grid instability/failure was split into two codes I and J. The new code 'I' applies to the energy that was not produced because of grid limited capacity to transmit available power of the reactor unit. The code J applies to the energy that was not produced because of grid failure (loss of grid) or grid instability.
(l) The new cause code O was introduced for generation losses that result from market regulations when priority in dispatching is given some generating units (renewables) also known as "must-run" units. If this cause cannot be distinguish the related losses can be included in the cause code K – load following. Any power reduction that is caused by low market prices should not be included in this category because such regulation remains under the plant management control.

Systems / components involved in the outage:

Selection of a system (from the table) and component/subsystem (from the dropdown list) primarily involved in /affected by the outage.

Clarifying notes:

(a) For a single outage (full or partial), only one system may be selected. If two or more systems were involved in the outage, select either the system directly causing the outage or the one being most significantly affected.
(b) Outages records with cause codes (A), (E) must be completed with system/component codes. Outages records with other cause codes can be, whenever applicable, completed with system/component codes.
(c) If no particular system could be specified from the general system group, enter the general system code "xx.00".
(d) In case a particular system was involved in the outage, but no suitable code was found in the list, choose the appropriate general system group and enter the "other" code "xx.99".
(e) The choice 'None' is applicable for outage records if no system was involved/affected.
(f) The system code consists of following codes:

Nuclear Systems

11.00	*Reactor and Accessories*
11.01	*Reactor vessel and main shielding (including penetrations and nozzles)*
11.02	*Reactor core (including fuel assemblies)*
11.03	*Reactor internals (including steam separators/dryers - BWR, graphite, pressure tubes)*

11.04 Auxiliary shielding and heat insulation
11.05 Moderator and auxiliaries (PHWR)
11.06 Annulus gas system (PHWR/RBMK)
11.99 None of the above systems

12.00 Reactor I&C Systems

12.01 Control and safety rods (including drives and special power supply)
12.02 Neutron monitoring (in-core and ex-core)
12.03 Reactor instrumentation (except neutron)
12.04 Reactor control system
12.05 Reactor protection system
12.06 Process computer
12.07 Reactor recirculation control (BWR)
12.99 None of the above systems

13.00 Reactor Auxiliary Systems

13.01 Primary coolant treatment and clean-up system
13.02 Chemical and volume control system
13.03 Residual heat removal system (including heat exchangers)
13.04 Component cooling system
13.05 Gaseous, liquid and solid radwaste treatment systems
13.06 Nuclear building ventilation and containment inerting system
13.07 Nuclear equipment venting and drainage system (including room floor drainage)
13.08 Borated or refuelling water storage system
13.09 CO_2 injection and storage system (GCR)
13.10 Sodium heating system (FBR)
13.11 Primary pump oil system (including RCP or make-up pump oil)
13.12 D_2O leakage collection and dryer system (PHWR)
13.13 Essential auxiliary systems (GCR)
13.99 None of the above systems

14.00 Safety Systems

14.01 Emergency core cooling systems (including accumulators and core spray system)
14.02 High pressure safety injection and emergency poisoning system
14.03 Auxiliary and emergency feed-water system
14.04 Containment spray system (active)
14.05 Containment pressure suppression system (passive)
14.06 Containment isolation system (isolation valves, doors, locks and penetrations)
14.07 Containment structures
14.08 Fire protection system
14.99 None of the above systems

15.00 Reactor Cooling Systems

15.01 Reactor coolant pumps/blowers and drives
15.02 Reactor coolant piping (including associated valves)
15.03 Reactor coolant safety and relief valves (including relief tank)
15.04 Reactor coolant pressure control system
15.05 Main steam piping and isolation valves (BWR)
15.99 None of the above systems

16.00 Steam generation systems

16.01 Steam-generator (PWR), boiler (PHWR, AGR), steam drum vessel (RBMK, BWR)
16.02 Steam generator blow-down system

16.03 Steam drum level control system (RBMK, BWR)
16.99 None of the above systems
17.00 Safety I&C Systems (excluding reactor I&C)
17.01 Engineered safeguard feature actuation system
17.02 Fire detection system
17.03 Containment isolation function
17.04 Main steam/feed-water isolation function
17.05 Main steam pressure emergency control system (turbine bypass and steam dump valve control)
17.06 Failed fuel detection system (DN monitoring system for PHWR)
17.07 RCS integrity monitoring system (RBMK)
17.99 None of the above systems

Fuel and Refuelling Systems

21.00 Fuel Handling and Storage Facilities
21.01 On-power refuelling machine
21.02 Fuel transfer system
21.03 Storage facilities, including treatment plant and final loading and cask handling facilities
21.99 None of the above systems

Secondary plant systems

31.00 Turbine and auxiliaries
31.01 Turbine
31.02 Moisture separator and re-heater
31.03 Turbine control valves and stop valves
31.04 Main condenser (including vacuum system)
31.05 Turbine by-pass valves
31.06 Turbine auxiliaries (lubricating oil, gland steam, steam extraction)
31.07 Turbine control and protection system
31.99 None of the above systems
32.00 Feed-water and Main Steam System
32.01 Main steam piping and valves
32.02 Main steam safety and relief valves
32.03 Feed-water system (including feed-water tank, piping, pumps and heaters)
32.04 Condensate system (including condensate pumps, piping and heaters)
32.05 Condensate treatment system
32.99 None of the above systems
33.00 Circulating Water System
33.01 Circulating water system (pumps and piping/ducts excluding heat sink system)
33.02 Cooling towers / heat sink system
33.03 Emergency ultimate heat sink system
33.99 None of the above systems
34.00 Miscellaneous Systems
34.01 Compressed air (essential and non-essential / high-pressure and low-pressure)
34.02 Gas storage, supply and cleanup systems (nitrogen, hydrogen, carbon dioxide etc.)
34.03 Service water / process water supply system (including water treatment)
34.04 Demineralized water supply system (including water treatment)

34.05 Auxiliary steam supply system (including boilers and pressure control equipment)
34.06 Non-nuclear area ventilation (including main control room)
34.07 Chilled water supply system
34.08 Chemical additive injection and makeup systems
34.09 Non-nuclear equipment venting and drainage system
34.10 Communication system
34.99 None of the above systems
35.00 All other I&C Systems
35.01 Plant process monitoring systems (excluding process computer)
35.02 Leak monitoring systems
35.03 Alarm annunciation system
35.04 Plant radiation monitoring system
35.05 Plant process control systems
35.99 None of the above systems

Electrical Systems

41.00 Main Generator Systems
41.01 Generator and exciter (including generator output breaker)
41.02 Sealing oil system
41.03 Rotor cooling gas system
41.04 Stator cooling water system
41.05 Main generator control and protection system
41.99 None of the above systems
42.00 Electrical Power Supply Systems
42.01 Main transformers
42.02 Unit self-consumption transformers (station, auxiliary, house reserve etc.)
42.03 Vital AC and DC plant power supply systems (medium and low voltage)
42.04 Non-vital AC plant power supply system (medium and low voltage)
42.05 Emergency power generation system (e.g. emergency diesel generator and auxiliaries)
42.06 Power supply system logics (including load shed logic, emergency bus transfer logic, load sequencer logic, breaker trip logic etc.)
42.07 Plant switchyard equipment
42.99 None of the above systems

Operational mode:

Selection of one of the following operational modes describing the status of the unit immediately before the outage:

1: Power operation
2: Start-up/shutdown operation
3: Hot standby (reactor subcritical)
4: Hot shutdown (reactor subcritical)
5: Cold shutdown (reactor subcritical)
6: Reactor pressure vessel open

Description of the outage:

The text in this field should describe briefly the nature of the outage and provide details. It is desirable that the description provides information in addition to that provided in codes.

Clarifying notes:

(a) In the description it is possible to specify general causes in details: the type of human factor (operator mistake, omission, failure to monitor plant processes), the type of equipment failure (spurious actuation of a system, component trip, damage or malfunction), the type of adverse environmental condition (frost, lightning, high sea), the type of load following operation (frequency control, reserve shutdown), the cause of fire etc.

(b) For outage records with cause code (Z) – Others, the description should provide information about the direct cause.

(c) If applicable, provide details of the actual type of operation/activity in the particular mode (e.g. power ascension after an outage; steady power operation at rated or reduced power upon the grid dispatcher's request etc.)

5.4 QUALITY CONTROL OF PRODUCTION DATA

WEDAS provides supporting function to improve and maintain data quality in the production data module.

Each operational data screen contains in the top-right corner the following functions:

- Consistency checks
- Performance indicators

Data providers are encouraged to use these functions before submitting data to the system.

5.4.1 Consistency Checks

WEDAS offers sophisticated consistency tests including crosschecks of data elements from different data sections (Annual Information, Monthly Production, Outages etc.) These tests consider outage causes and their effect on unit availability.

For individual consistency checks, tolerance limits have been established:

- If there is inconsistency within the given tolerance limits, the identified difference is shown in brown colour. For published data, these differences are accepted and data are considered consistent.
- If there is inconsistency exceeding these limits, the difference is shown in red colour and inconsistency sign is not cleared for published data.

The consistency tests are divided into eight sections:

I. On-line Hours

This test compares on-line hours for each month, when the unit was connected to the grid, with the result of calculation from full outage records (the second character of the type code is F). As an outage can start in one month and finish in a following month, the duration of each full outage is interpolated into one month and for each month a difference between the reference period and the total duration of full outages in the month is calculated.

Rule: On-line Hours = (Period Reference Hours) –Σ(Full Outage Hours)

Each full outage includes also the period of shutting down and starting up, when the unit is (still or already) connected to the grid. If these "marginal" periods are reported in the PRIS as a part of the full outage (i.e. they are not reported separately as partial outages), it brings a certain inaccuracy in the number of on-line hours. Therefore, the 24 hour per month tolerance was selected for this case.

II. Energy generated and energy losses

This energy balance test compares reported values of electricity generated with the possible production which is a value calculated from reference energy generation and energy losses reported in monthly records (unavailability) and energy losses interpolated to a month from outages which are not related to plant unavailability - outage cause codes I, J, K, M, O, U.

Rule: Actual Production = Possible production

Possible production = (Reference Hours) ×(Reference unit power)– Σ (Energy losses due to plant unavailability) – Σ (Energy losses due to outages with one of cause codes I, J, K, M, O, U)

Operation at a power higher than the reference unit power results in "overproduction", which causes difference between actual and possible production. In this test a tolerance limit for overproduction has not been established. For missing energy a tolerance limit is equal to 10 hours of operation at the reference unit power.

III. Unplanned energy losses

This test compares unplanned energy losses (UEL = FEL + EPL - reported monthly in the "Unavailability Data" part) with the interpolated energy loss from outages coded as unplanned (the first character in the outage type code is "U".)

Rule: UEL = Σ (Energy losses due to outages with type code "Uxx")

If some short-term outages (not considered as "significant") are not reported, there may be discrepancy in the above rule. Therefore, the tolerance limit for unplanned energy losses is equal to 10 hours of operation at the reference unit power.

IV. Planned energy losses

This test compares planned energy losses (PEL) with the interpolated energy loss from outages coded as planned outages (the first character in the outage type code is "P".)

Rule: PEL = Σ (Energy losses due to outages with type code "Pxx")

If some short-term outages are not reported, there may be discrepancy in the above rule. Therefore, the tolerance limit for planned energy losses is equal to 10 hours of operation at the reference unit power.

V. Other energy losses

This test compares other energy losses (XEL) with the interpolated energy loss from outages coded as external outages (the first character in the outage type code is "X".) due to causes affecting unit availability (cause codes other than I, J, K, M, O, U).

Rule: XEL = Σ (Energy losses due to outages with type code "Xxx" and Cause Code other than I, J, K, M, O, U)

If some short-term outages are not reported, there may be deviations from the above rule. Therefore, the tolerance limit for external energy losses is equal to 10 hours of operation at the reference unit power.

VI. Energy losses due to Full Outages

This test finds out, whether the energy loss due to full outages (the second character of the type code is F) corresponds to the outage duration (it assumes the unit is disconnected from the grid during that time).

Rule: Outage energy loss = (Hours of outage duration) × (Reference unit power)

Similarly to the Test I, results of this test may be affected by the shutting-down and starting-up periods, which are mostly included in the full outage data. Therefore, 24 hours of operation at the reference power has been established as the tolerance limit.

VII. Lifetime Electricity Generation

This test compares a reported lifetime generation with the sum of a previous year value of lifetime generation and current year generation.

Rule: Lifetime Electricity Generation (LEG) = (previous year's LEG) + (Electricity Generation for the current year)

VIII. Scrams

Compares numbers of scrams reported in the Operating Experience (OE) data set with a number of outage records coded as scram.

Rule: The number of automatic scrams in OE must be the same as the number of (combined) outages in the year with outage of type UF4 or XF4

The number of manual scrams in OE must be same as the number of (combined) outages in the year with outage type UF5 or XF5

5.4.2 Performance indicators

WEDAS offers the option to perform calculation of all basic performance indicators using the entered data elements directly.

Data providers are encouraged to use this function as a next stage of data quality control before data submission.

The following performance indicators can be calculated in the WEDAS system:

- EAF: Energy Availability Factor;
- EUF: Energy Unavailability Factor;
- PUF: Planned Energy Unavailability Factor;

- UUF: Unplanned Energy Unavailability Factor;
- XUF: External Energy Unavailability Factor;
- UCF: Unit Capability Factor;
- UCL: Unit Capability Loss Factor;
- FLR: Forced Loss Rate;
- OF: Operation Factor;
- LF: Load Factor;
- UA7: Unplanned Automatic Scram Rate;
- US7: Unplanned Scram Rate.

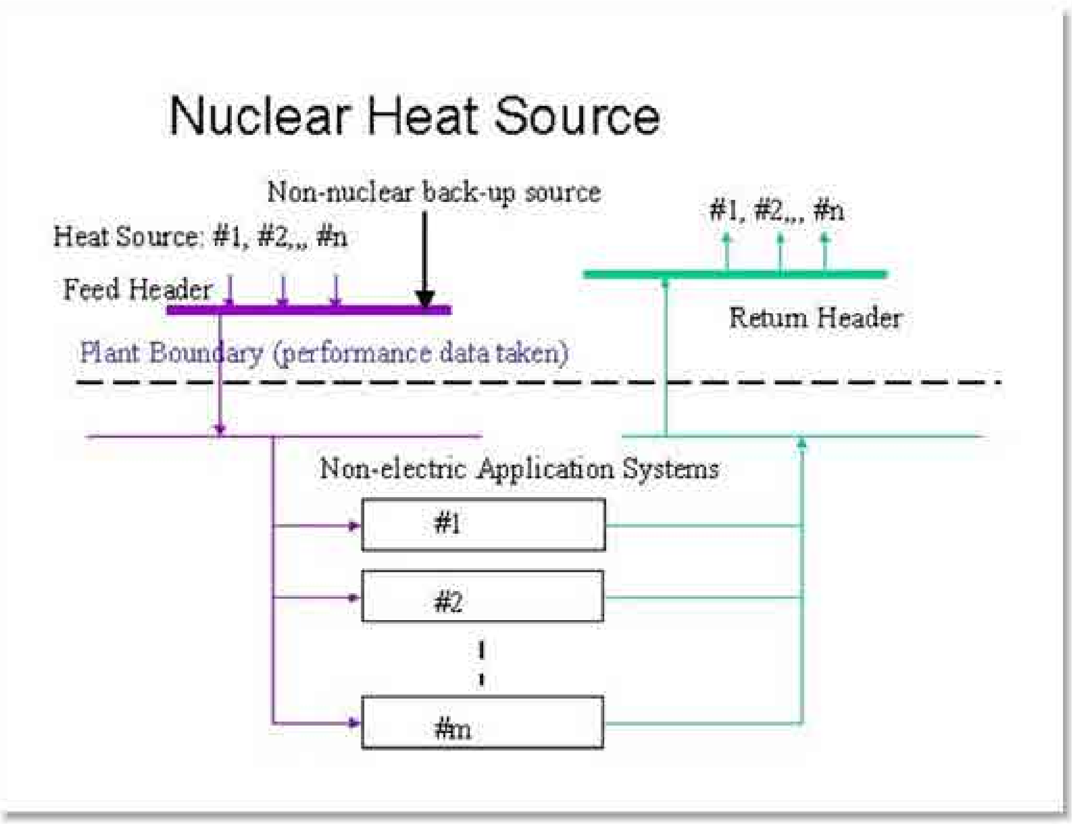
For definitions of performance indicators see [1] or Annex 3.

Indicator values can be calculated for the months for which the data have been entered. If input data is available, quarterly or annual indicator values can also be calculated. To compare the current indicator values with long-term performance, indicator values for the last 12 months and 36 months are also provided.

The calculation table is complemented by performance statistics of units with the same reactor type.

6. NON-ELECTRICAL APPLICATION DATA

Some power plant units produce a portion of their output energy in the form of heat/steam for non-electrical applications like desalination, district heating and industrial heat. This energy should be reported, provided the production of heat/steam reduces the actual output electrical power below the reference unit power defined in Section 5.1.1.



Note: At some nuclear power plants (e.g., in Russia), there may be two feed/return headers, one each for district heating and process industry.

FIG. 6-1: Schematic diagram of energy supply to a NEA unit

6.1 HIGHLIGHTS

Highlights:

The text field is intended to provide highlights of energy delivery to non-electrical application systems during the reported year. Any relevant information may be entered.

Limitations:

This text data field may provide explanation when the operation of non-electrical application systems was limited by insufficient heat delivery from the nuclear heat source(s) during the reported year. Provide information as what caused this and what countermeasures were taken, etc.

6.2 MONTHLY DATA FOR HEAT CONSUMPTION

6.2.1 Energy supply for district heating and process heat

Month	District Heating (PDH) [Gcal]	Process Heat (PPH) [Gcal]	Total Heat Delivery (PDH+PPH) [Gcal]	Total needed from non-nuclear back-up heat source [Gcal] #	Data status
Jan	32036	28601	60637	0	Published
Feb	31451	22349	53800	0	Published
Mar	11098	10756	21854	0	Published
Apr	11407	11448	22855	0	Published
May	1433	1448	2881	0	Published
Jun	979	991	1970	0	Published
Jul	9470	9578	19048	0	Published
Aug	6205	6260	12465	0	Published
Sep	0	0	0	0	Published
Oct	0	0	0	0	Published
Nov	5853	618	6471	0	Published
Dec	18643	17754	36397	0	Published
Total	**128575**	**109803**	**238378**	**0**	**Published**

If the back-up heat source is used for multiple units, please clarify:

FIG. 6-2. NEA data for district and process heat

District Heating, PDH:

Data entry for monthly energy in giga-calories [Gcal] supplied for district heating. The thermal energy provided during the reference month for district heating delivered in the form of heat (steam or hot water) measured as the difference between the plant feed (outlet) and return (inlet) headers (see Figure 6-1).

District heating is the heat provided to space heaters installed at houses, buildings and facilities outside the power plant for warming the living environment. In some cases supply of hot water for living is combined with this system.

If it is difficult to provide individual data for (PDH), the total data for (PDH+PPH) are acceptable. If monthly data are difficult to provide, the annual total data are acceptable.

Process Heating, PPH:

Data entry for monthly energy in giga-calories [Gcal] supplied for process heating.

The thermal energy provided during the reference period for process heat delivered in the form of heat (steam or hot water) measured as the difference between the plant feed (outlet) and return (inlet) headers (see Figure 6-1).

Process heating is the heat provided as an energy source to chemical processes for producing commodities. Typical products are paper (cardboard), concrete, heavy water and saltern. Utilization of waste heat in the form of warm water or steam (for example for use in the fishery industry or in green houses) is also possible but is usually excluded from reporting because it does not affect heat balance of the reactor unit.

Back-up Source:

Data entry for monthly energy in giga-calories [Gcal] supplied from non-nuclear back-up heat source. The thermal energy, provided by the non-nuclear back-up heat source, if applicable, to compensate insufficient availability of heat from the nuclear reactor. This applies only when the back-up heat source is under control of the nuclear power plant.

The non-nuclear back-up heat source may be installed at a nuclear power plant with multiple units in order to secure heat delivery capability from the plant to compensate insufficient availability of heat from the nuclear reactor.

Clarifying text for back-up heat source used:

If the back-up heat source is used for multiple units, please clarify, why the operation of non-electric application systems was limited by insufficient heat delivery from the nuclear heat source(s). Give descriptive explanations of what caused this, what countermeasures were taken, etc.

6.2.2 Energy supply for water desalination

Month	Thermal energy provided for Distillation [Gcal]	Electrical energy provided for Reverse Osmosis Process [MW(e)·h]	Water Production [m³]	Data status
Jan	2046		25436	Published
Feb	1915		24099	Published
Mar	2282		32171	Published
Apr	1398		23642	Published
May	1968		28355	Published
Jun	2405		31029	Published
Jul	3104		42791	Published
Aug	3040		42149	Published
Sep	2028		33319	Published
Oct	2398		36726	Published
Nov	2793		37694	Published
Dec	793		10524	Published
Total	**26170**	**0**	**367836**	**Published**

FIG. 6-3.. NEA data for desalination

Thermal Energy Provided for Distillation, PDI:

Data entry for monthly energy data in giga-calories [Gcal] supplied for water distillation.

Enter the thermal energy provided during the reference period to the desalination systems of distillation type (multi-stage flash or multi-effect distillation) or in the form of heat measured as the difference between at the plant feed (outlet) and return (inlet) headers, or between the heat extraction points and return points in the case of in-plant facilities.

Electrical Energy Provided for Reverse Osmosis Process, PRO:

Data entry for monthly electricity in mega-watt-hours [MW(e)·h] supplied for reverse osmosis.

If applicable, enter the electrical energy provided during the reference period to the desalination systems of reverse osmosis process. By definition this electrical energy is a part of in-site power.

Desalinated Water Volume, DWV:

Data entry for volume in cubic meters [m^3] of water produced by the desalination systems.

The monthly water production and its fraction delivered to "off-site" consumers.

7. DECOMMISSIONING DATA

Decommissioning of a nuclear power plant is the process of facilities dismantling, fuel transfer, contaminants removal, contaminated material disposal and other activities. This is the process to reduce the risk of public radioactive exposure to radioactive materials remaining at the plant to a safe and reasonably low level. Activities such as characterization, decontamination, dismantling and demolition of the installations are performed during particular periods.

Decommissioning data in WEDAS are organised in four screens: 1) Main information; 2) Decommissioning phases; 3) Fuel management; 4) Contractors and milestones.

Experiences on decommissioning are collected by compiling information of the techniques used in decommissioning activities and disseminated to Member States. The data can be completed or edited anytime and only the latest update is maintained in the database. It is expected that data are updated when necessary.

7.1 MAIN INFORMATION

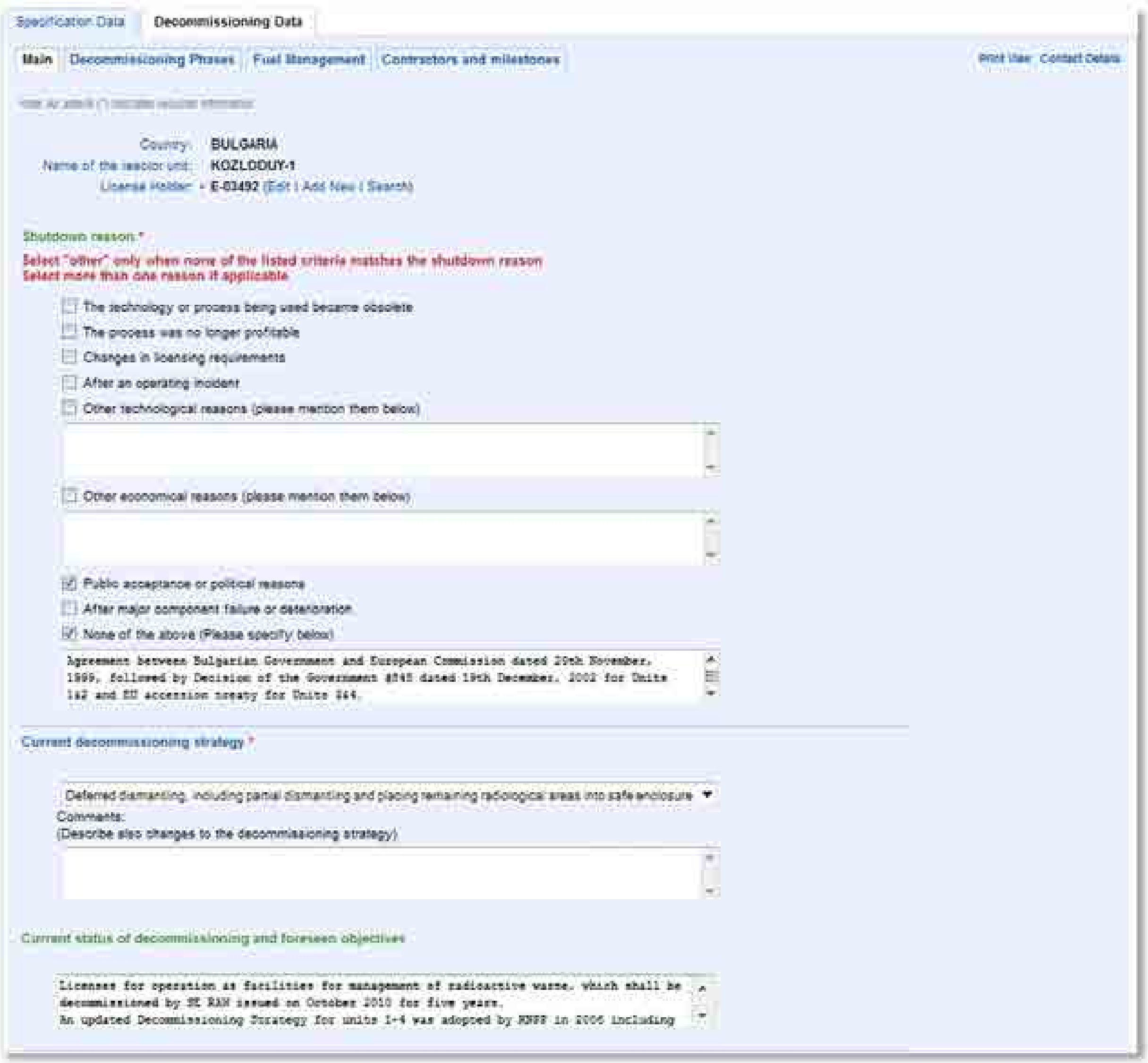


FIG.7-1: Decommissioning main information

Country:

Read-only information from the reactor unit specification.

Name of the reactor unit:

Read-only information from the reactor unit specification.

License Holder:

A short name (abbreviation) of the license holder. The license holder is a holder of a legal document granting authorization to perform specified activities related to the decommissioning of a nuclear power plant

The license holder specification contains additional information:

- Full name
- Address
- Website – URL of an official website of the company

Shutdown reason:

Selection of one or more reasons for reactor unit shutdown.

Options for selection:

- The technology or process being used became obsolete
- The process was no longer profitable
- Changes in licensing requirements
- After an operating incident
- Other technological reasons (please mention them below)
- Other economic reasons (please mention them below)
- Public acceptance or political reasons
- After major component failure or deterioration
- None of the above (Please specify below)

Some selection criteria have a text box for additional information. The category 'other' should be used only when none of the listed criteria matches the shutdown reason.

Current decommissioning strategy:

Selection of the currently applied strategy for decommissioning.

Options for selection:

- Immediate dismantling and removal of all radioactive materials
- Deferred dismantling, placing all radiological areas into safe enclosure
- Deferred dismantling, including partial dismantling and placing of the remaining radiological areas into safe enclosure
- In situ disposal, involving encapsulation of radioactive material and subsequent restriction of access
- None of the above (Please specify below)

Clarifying notes:

(a) Dismantling: The disassembly and removal of any structure, system or component during decommissioning. Dismantling can be performed immediately after permanent retirement of a nuclear facility or may be deferred.

(b) Encapsulation: (1) Immobilization of dispersed solids by mixing with a matrix material in order to produce a waste form (2) Emplacement of a solid waste form (e.g. spent fuel assemblies) in a container.

(c) In-situ disposal (also called entombment): Decommissioning strategy where the nuclear facility is disposed wholly or partly at its existing location.

(d) Safe enclosure: A condition of a nuclear facility during the decommissioning process in which only surveillance and maintenance takes place. If a safe enclosure licence (e.g. possession-only licence) was granted, insert that date as the start year of either active or passive safe enclosure period.

Comments:

The text box for additional information about the decommissioning strategy or description of changes in the strategy.

Current status of decommissioning and foreseen objectives:

The text box for information about the future steps and objectives of decommissioning.

7.2 DECOMMISSIONING PHASES

FIG 7-2. Decommissioning phases screen

Scheduled decommissioning Phases:

Selection of applicable phases and specification:

- Phase start year
- Phase end years
- Comments to a phase

To add other specific phases, click on the **Add** to specify a new phase.

Clarifying notes:

(a) Decommissioning plan: documentation containing information on the way of proceeding with the decommissioning of a facility.

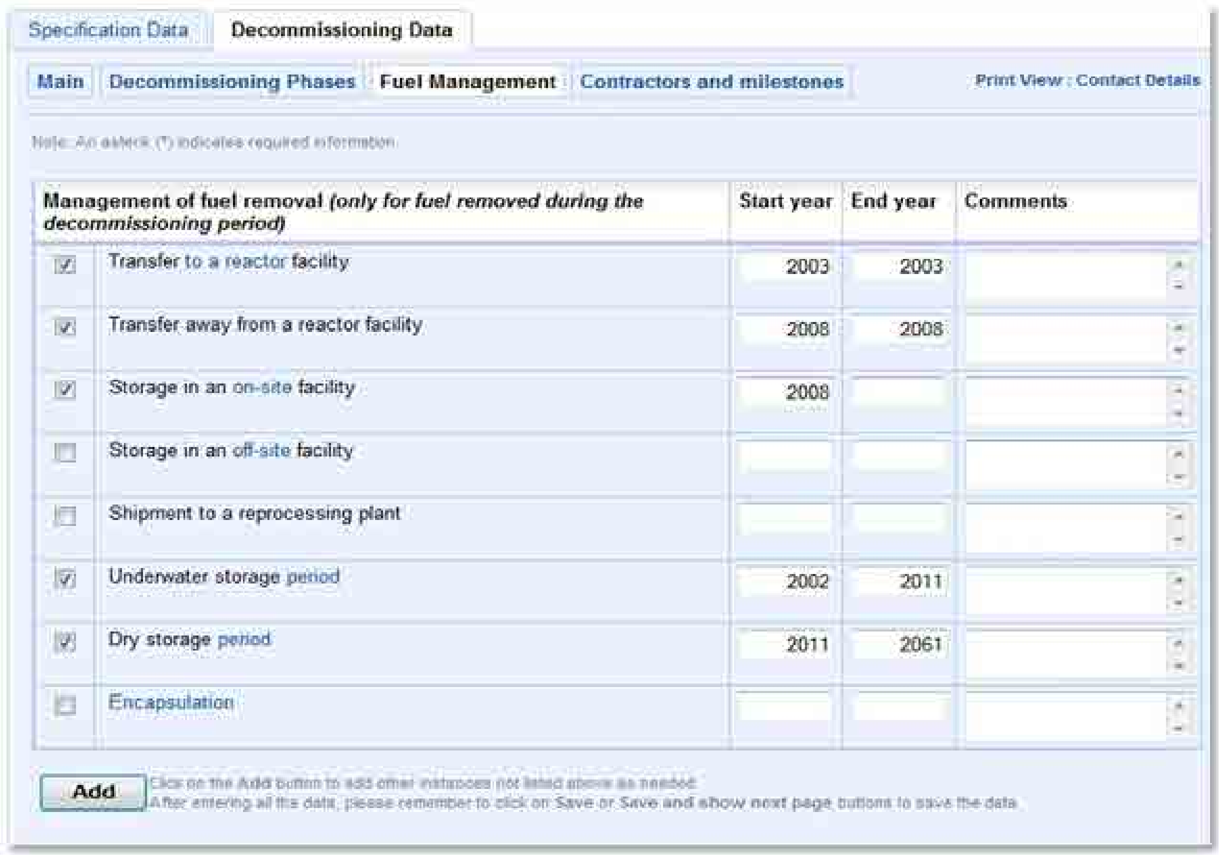
(b) On-site: within the site area; Off-site: outside the site area.

(c) Safe enclosure: a condition of a nuclear facility during the decommissioning process in which only surveillance and maintenance takes place. If a safe enclosure licence (e.g. possession-only licence) was granted, insert that date as the start year of either active or passive safe enclosure period.

(d) Dismantling: the disassembly and removal of any SSC during decommissioning. Dismantling can be performed immediately after retirement or may be deferred.

(e) In some information sources the term 'decommissioning steps' is used rather than decommissioning phases.

7.3 FUEL MANAGEMENT


Specification Data | Decommissioning Data

Main | Decommissioning Phases | Fuel Management | Contractors and milestones — Print View : Contact Details

Note: An asterisk (*) indicates required information.

	Management of fuel removal *(only for fuel removed during the decommissioning period)*	Start year	End year	Comments
☑	Transfer to a reactor facility	2003	2003	
☑	Transfer away from a reactor facility	2008	2008	
☑	Storage in an on-site facility	2008		
☐	Storage in an off-site facility			
☐	Shipment to a reprocessing plant			
☑	Underwater storage period	2002	2011	
☑	Dry storage period	2011	2061	
☐	Encapsulation			

Add — Click on the Add button to add other instances not listed above as needed. After entering all the data, please remember to click on Save or Save and show next page buttons to save the data.

FIG 7-3. Fuel management screen

Management of fuel removal (only for fuel removed during the decommissioning period):

Selection of applicable fuel management phases and specification:

- Phase start year;
- Phase end years;
- Comments to a phase.

To add other specific fuel management phases not listed in the table click on the **Add** button and specify a new phase.

Clarifying notes:

(a) At-reactor storage: Spent fuel storage that is integral or associated with a reactor and part of the refuelling operation.
(b) Storage Period: The period when spent fuel is kept under storage and may include future periods even after completion of NPP decommissioning.
(c) Encapsulation: (1) Immobilization of dispersed solids by mixing with a matrix material in order to produce a waste form (2) Emplacement of a solid waste form (e.g. spent fuel assemblies) in a container.

7.4 CONTRACTORS AND MILESTONES

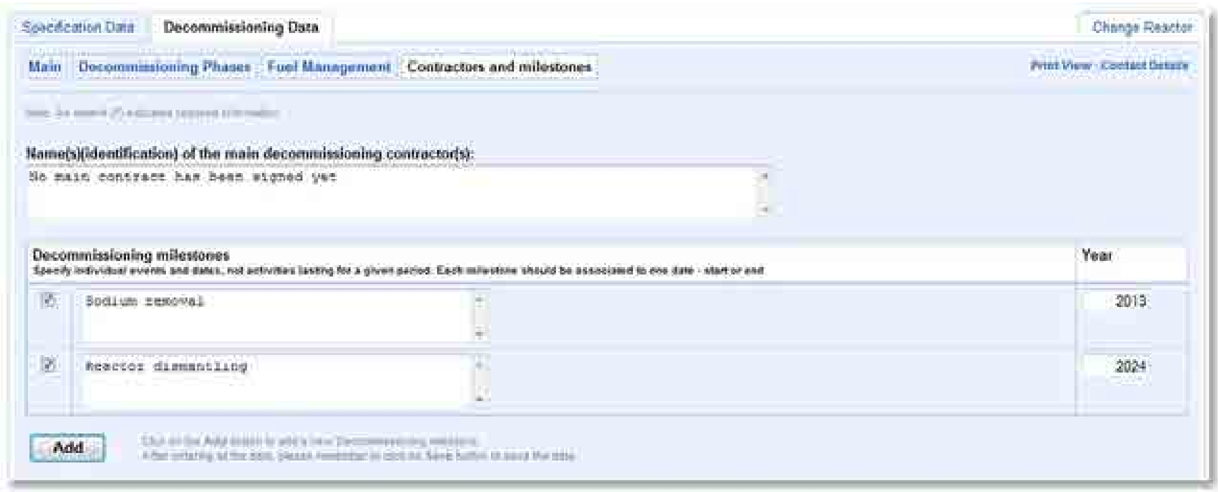


FIG. 7-4. Decommissioning contractor and milestone screen.

Main decommissioning contractor(s):

Specify one or more decommissioning contractors.

Decommissioning milestones:

Specify main decommissioning events and milestones and year of their occurrence.

For an activity lasting for an extended period specify either its beginning or finishing.

To add another record click on the **Add** button and specify a new milestone.

8. INITIATING EVENTS DATA

An initiating event (IE) is an incident that requires an automatic or operator initiated action to bring the plant into a safe and steady-state condition, where in the absence of such action the core damage states of concern can result in severe core damage. Initiating events are usually categorized in divisions of internal and external initiators reflecting the origin of the events.

Initiating event frequency is important for probabilistic safety analyses but due to the rare occurrence, the statistics derived available via personal professional experience might be inadequate. The IAEA has been providing assistance to Member States in PSA applications, risk informed decision making and maintenance optimization.

The PRIS initiating events module which can be named as 'Scram related initiating events' supports IE frequency analyses through the particular PRIS outage records:

- Unplanned scrams (coded as UF4, UF5, XF4, XF5)
- Selected forced controlled shutdowns (coded as UF2)

This PRIS module effectively identifies initiating events for calculating realistic IE frequencies from the worldwide shared data.

For the purpose of the IE module, generic lists of initiating events have been developed for the following types and models of reactor units: PWR, VVER, BWR, PHWR (CANDU), and LWGR (RBMK).

The IE module allows assignment of selected outage records to a particular initiating event code from the generic list and provides additional information needed for IE analyses.

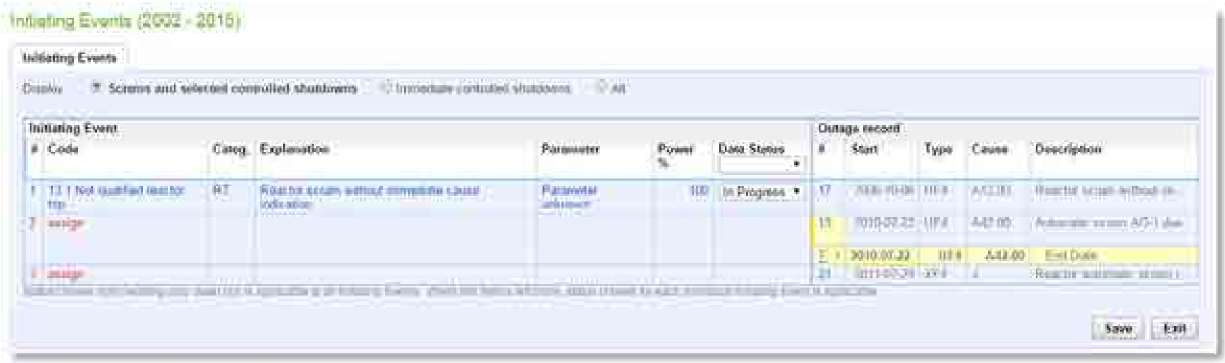


FIG. 8-1: Initiating Event screen

The IE screens provide a list of all scrams and unplanned controlled immediate shutdowns that have been reported for the reactor unit in outage records since 2002.

Currently the year 2002, when the PRIS outage coding system was modified, limits selection of outage records, nevertheless the recoding of historical records will allow this limitation.to be removed.

WEDAS has three screens for the IE module:

1. **List of IE records**: This screen contains all unplanned scrams (either assigned or not assigned yet to a particular initiating event) and those unplanned controlled immediate shutdown records that were selected in the second screen as IE records.

2. **Controlled shutdowns**: This screen contains all forced controlled shutdown records from PRIS outages that were coded by the ‘UF2’ type code, as IE candidates. The screen allows selection of those forced shutdowns that are evaluated as an initiating event. The IE code ‘Administrative shutdown’ is the only option for those records. When IE code and additional information are specified, the record is copied as an IE record into screen 1.
3. **All:** This screen provides an overview of all scrams and all controlled shutdowns reported for the reactor unit in the outage data module.

The assigned and completed IE record includes the following information:

- All information reported in the outage records (Chapter 5.3)
- Initiating event code from the IE generic list
- Additional information. It is necessary as the originally reported outage information and codes were not intended to support initiating event analysis

To assign IE code and to provide additional information click on any of records listed in the table of landing screens. This results in opening the IE data screen (Figure 8-2).

FIG. 8-2. Initiating Events data screen

Together with data entry fields, the IE data screen contains all data details (read-only) of the selected outage record in the bottom part. The buttons “<<prev” and “next>>” allow easy movement to the other IE records.

The IE record which is specified as based on the controlled shutdown (UF2) record can be excluded from the IE records using the button ‘Exclude’. This button is not active for records based on scrams. When an outage record was reported in more fragments, all linked fragments as shown and the combined outage is considered as one initiating event. The IE data use the same data status controls as described in 2.4.

Additional data items for IE records:

Initiating Event Code:

Selection of the initiating event code using the drop down list of the generic initiating events offered by PRIS-WEDAS for the relevant reactor type.

WEDAS provides a drop down list of IE codes with IE description for the relevant reactor type. The generic list codes are synchronised across the reactor types. Annex 1 contains lists of generic IE codes for particular reactor types and models.

Clarifying notes:

(a) The data provider can select only one code from the list.
(b) For selected forced controlled shutdowns the code of "Administrative shutdown" is automatically assigned.

Explanation:

The explanation should provide the reason behind the assignment of a particular IE code.

In order to ensure enough information for the user to judiciously decide whether the event belongs to the IE for which the user wants to calculate the frequency, the explanation and justification for selection of an IE code from the drop down list should be provided.

Clarifying notes:

(a) In case of a break in the secondary part (boiler feed water, steam line) or a break in the primary part, the initial break flow should be approximated and given.
(b) To the extent possible, a summary of the event progression leading to reactor scram should be given including any operator error or intervention.
(c) If an investigation was completed then the direct, apparent, or root cause (as the case may be) may be given.

The parameter on which the reactor scram occurred:

The parameter on which the reactor scram occurred, e.g. low primary pressure.

When more than one trip parameters are enunciated one after the other, the parameter should indicate the first trip parameter on which scram actually occurred.

Power level in % of RUP:

The reactor power level in percentage at the time the initiating event scram occurred.

9. CONSTRUCTION PERIOD DATA

This PRIS data module is under development.

The objective of the new PRIS module is to summarise information that can be used for an international survey and sharing which would benefit those planning to construct new power reactors, especially the Member States considering construction of the first power reactor.

The final questionnaire for the construction/commissioning period data module which was agreed by PRIS Technical Meeting in 2012 is in Annex 2 of this manual.

The concept for international shared information on construction and commissioning of new nuclear power plants consists of the following information:

- decision making process;
- project organisation and management;
- original schedule and its adherence;
- reasons for delay;
- period of suspended construction;
- type of contract;
- milestones;
- contractors and subcontractors;
- experience from construction – main issues , significant events, influencing factors.

The data may be obtained for on-going projects and commissioned projects since 1990.

REFERENCES

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, The Power Reactor Information System (PRIS) and its Extension to Non-electrical Applications, Decommissioning and Delayed Projects Information, IAEA Technical Reports Series No. 428, IAEA, Vienna (2005).

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, International Outage Coding System for Nuclear Power Plants, IAEA-TECDOC-1393, IAEA, Vienna (2004).

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Power Plant Design Characteristics, IAEA-TECDOC-1544, IAEA, Vienna (2007).

[4] PRIS Public Website, www.iaea.org/pris

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ABBREVIATIONS

AGR	advanced gas cooled reactor
BWR	boiling water reactor
DWV	desalinated water volume
EAF	energy availability factor
ECCS	emergency core cooling system
EG	electricity generated
EL	energy loss
EPL	extensions of planned energy loss
EUF	energy unavailability factor
FBR	fast breeder reactor
FEL	forced energy loss
FLR	forced loss rate
Gcal	gigacalorie
GCR	gas cooled reactor
GW	gigawatt
GW·h	gigawatt-hour
HTGR	high temperature gas cooled graphite moderated reactor
HWGCR	heavy water moderated gas cooled reactor
IAEA	International Atomic Energy Agency
ID	identification
IE	initiating event
IRS	incident reporting system
ISO	International Organization for Standardization
LF	load factor
LFH	load factor including heat
LTS	long term shutdown
LWGR	light water cooled graphite moderated reactor
MW	megawatt
MW·h	megawatt-hour
NAS	number of automatic scrams
NCH	number of critical hours
NEA	non-electrical application
NEG	electrical equivalent of non-electrical energy generated
NMS	number of manual scrams
NPP	nuclear power plant
NSSS	nuclear steam supply system
OC	operating cycle
OE	operating experience
OF	operation factor
PBMR	pebble bed modular reactor
PDH	district heating energy
PDI	distillation energy
PEL	planned energy loss
PHWR	pressurized heavy water reactor
PI	performance indicator

PPH	process heating energy
PRIS	power reactor information system
PRIS LO	PRIS liaison officer
PRISTA	PRIS-Statistics
PRO	distillation electricity
PUF	planned unavailability factor
PWR	pressurized water reactor
RBMK	Russian model of LWGR
RCP	reactor coolant pump
REG	reference energy generation
RUP	reference unit power
SG	steam generator
SGHWR	steam generating heavy water reactor
SSC	structure, system or component
t	on-line hours
T	reference period hours
TG	turbine-generator
TW·h	terawatt-hour
UA7	unplanned automatic scram rate
UCF	unit capability factor
UCL	unplanned capability loss factor
UEL	unplanned energy loss
URL	uniform resource locator
US7	unplanned scram rate
UUF	unplanned unavailability factor
VVER	Russian model of PWR
WANO	World Association of Nuclear Operators
WEDAS	web-enabled data acquisition system
XEL	externally caused energy loss
XUF	external unavailability factor

ENERGY UNITS AND CONVERSION FACTORS

Unit	Name
J	Joule
cal	Calorie
W·h	watt hour
(kg) ce	(kilogram) coal equivalent
(kg) oe	(kilogram) oil equivalent
m³ natural gas	cubic meter natural gas

Unit	kJ	Kcal	kW·h	kg ce	kg oe	m³ natural gas
1 kJ	1	0.2388	0.000278	0.000034	0.000024	0.000032
1 kcal	4.1868	1	0.001163	0.000143	0.0001	0.00013
1 kW·h	3 600	860	1	0.123	0.086	0.113
1 kg ce	29 308	7 000	8.14	1	0.7	0.923
1 kg oe	41 868	10 000	11.63	1.428	1	1.319
1 m³ natural gas	31 736	7 580	8.816	1.083	0.758	1

ANNEX I: GENERIC INITIATING EVENT LIST IN PRIS

Code	PWR	WWER	BWR	PHWR	RBMK
AS -	**Administrative shutdown**				
0.0	Administrative shutdown	Administrative shutdown	Administrative shutdown	Administrative shutdown	Administrative shutdown
EPI - Excess of primary inventory					
1.1	Inadvertent safety injection actuation	Inadvertent safety injection actuation	Inadvertent startup of HPCI/HPCS		Spurious ECCS actuation
1.2	Inadvertent injection to primary side from make-up water system	Inadvertent injection to primary side from make-up water system			
1.3	Startup of inactive coolant pump *1	Startup of inactive coolant pump *1			Actuation of an idle MCP
1.4			Recirculation control failure; increasing flow		
1.5			High feedwater flow during startup or shutdown		
1.6			Feedwater increasing flow at power		Excessive feedwater flow
1.7			Abnormal startup of idle recirculation pump		
1.8			Inadvertent startup of RCIC		
1.9					Reduction of feedwater temperature
ESSHR - Excess of secondary side heat removal					
2.1	Inadvertent SG level regulation valve operation lead to SG level increase	Inadvertent SG level regulation valve operation lead to SG level increase			
2.2	Increase in feedwater flow (one loop)	Increase in feedwater flow (one loop)			
2.3	Increase in feedwater flow (all loops)	Increase in feedwater flow (all loops)			
2.4		Inadvertent opening of steam dump valve to condenser (BRU-K)			
2.5				Symmetric SG blow-down line break outside RB	
2.6				Symmetric SG blow-down line break inside RB	
2.7				Asymmetric SG blow-down line break inside RB	

Code	PWR	WWER	BWR	PHWR	RBMK
FI - Fires					
3.1	Fire within plan	Fire within plan	Fire within plan	Fire within plan	Fire within plan
FL - Flood					
4.1	Floods	Floods	Floods	Floods	Floods
LO-LOCA - LOCA outside confinement					
5.1	Interfacing system LOCA	Interfacing system LOCA	Loss of Coolant Accident bypassing containment	HTS leaks into RCW/ interfacing LOCA	Break of a small diameter pipeline outside the ALS
5.2		Interfacing system LOCA through control rods intermediate cooling system outside confinement			
5.3		Interfacing system LOCA through MCPs intermediate circuit outside confinement			
5.4		Other Interfacing system LOCA outside confinement			
5.5				Blowback from HTS into ECC and rupture of ECC piping	
LOSP - Loss of power					
6.1	Loss of all off-site power	Loss of all off-site power	Loss of off-site power	Loss of all off-site power	Total loss of in-house power supply
6.2	Loss of power to necessary plant systems	Loss of power in switchyard	Partial loss of off-site power	-Total loss of Class IV power -Partial loss of Class IV power	Loss of in-house power supply
6.3	Loss of Vital AC Bus	-Loss of 0.4 kV/220 V power -Loss of essential 6 kV power	-Loss of 6.6 kV AC Power -Loss of 380 V AC Power	-Total loss of Class II power -Partial loss of Class II power	
6.4	Loss of Vital DC Bus	Loss of DC power	Loss of DC Power	Total loss of Class I power -Partial loss of Class I power	
6.5		Loss of transformer	Loss of auxiliary power (loss of auxiliary transformer)		
RPF - Reduction of primary flow					
7.1	Loss of RCS flow (one loop)	Loss of RCS flow due to unknown reason	-Recirculation control failure; decreasing flow -Trip of one recirculation pump	Partial loss of HTS flow due to failure of one pump	Trip of one MCP
7.2	Total loss of RCS flow	Trip of MCP	Trip of all recirculation pumps	Total loss of HTS pumped flow	Trip of several MCPs
7.3		MCP seizure	Recirculation pump seizure		MCP seizure

Code	PWR	WWER	BWR	PHWR	RBMK
7.4		Inadvertent closure of main circuit isolation valves			Spurious partial closure of the MCP throttling valve in an operating reactor
7.5			Loss of all feedwater flow		
7.6			Trip of one feedwater pump (or condensate pump)		
7.7			Feedwater low flow		
7.8			Low feedwater flow during startup or shutdown		
7.9			Loss of TICCW; Turbine Island Closed Cooling Water		
7.10				Channel flow reduced to > 70% of normal flow	
7.11				Channel flow reduced to < 70% of normal flow (severe flow blockage)	
7.12					Failure of the isolation disc of the DGH check valve
7.13					Shaft break of one of the MCPs
7.14					Break of a MCP check valve plate or of an MCP gate valve disc
LPPC - Loss of primary pressure control					
8.1	Pressurizer spray failure	-Failure to injection into pressurizer spray from MCP -Inadvertent pressurizer heaters activation			
8.2	High pressurizer pressure			HTS pressure control failure (high)	
8.3	Low pressurizer pressure	-Inadvertent injection into pressurizer spray from normal makeup system -Inadvertent injection into pressurizer spray from MCP -Pressurizer heaters failure or inadvertent disconnection		HTS pressure control failure (low)	
8.4			Pressure regulator fails to open		

Code	PWR	WWER	BWR	PHWR	RBMK
8.5			Pressure regulator fails to close		
8.6					Pressure control failure
LU-LOCA - LOCA inside confinement					
9.1	Leakage from control rods	Control rod ejection induced LOCA			
9.2	Leakage in primary system			-HTS leaks (< charging capacity) -HTS leaks (> charging capacity) -HTS LRV spuriously fails open	
9.3	Pressurizer leakage			-Break in piping upstream of the pressurizer relief valves or steam bleed valves -PRV spuriously fails open	
9.4	Stuck Open Safety Relief Valve	Inadvertent opening of pressurizer safety valve			
9.5	Large LOCA	Large pipeline primary side LOCA	Large Loss of Coolant Accident	Large LOCA	-Guillotine break of DGH -Guillotine break of downcomer -Guillotine break of the MCP pressure header vagy
9.6	Medium LOCA	Medium pipeline primary side LOCA	Medium Loss of Coolant Accident		
9.7	Small LOCA	Small pipeline primary side LOCA	Small Loss of Coolant Accident	-Pressure tube rupture -Pressure tube and calandria tube rupture -Feeder stagnation break -Feeder break -End fitting break with fuel ejection	-Break in the inlet pipeline of a fuel channel -Break in the outlet pipeline of a fuel channel -Break of a channel tube inside the reactor cavity -Partial (critical) break of the DGH
9.8	Very Small LOCA	Very small pipeline primary side LOCA	Very Small Loss of Coolant Accident		
9.9		-Gas removal system pipeline rapture -Inadvertent opening of gas removal system valve			
9.10				LOCA due to failure of closure plug	
9.11				FM induced small LOCA; no fuel ejection	

Code	PWR	WWER	BWR	PHWR	RBMK
9.12				FM induced small LOCA; with fuel ejection	
9.13				FM induced HTS leaks	
9.14					Rupture of water communication line
9.15					Rupture of a pipeline in the blowdown and cooling system
PRISL - Primary to secondary leakage					
10.1	Steam-generator tube rupture (PRISE - primary to secondary leakage)	Steam-generator tube rupture (single or multiple)		Steam-generator tube rupture (single or multiple)	
10.2		Steam-generator collector header leakage			
RA - Reactivity accident					
11.1	CVCS malfunction - boron dilution	Inadvertent boron dilution			
11.2	Uncontrolled rod withdrawal	Uncontrolled control rods withdrawal	Rod withdrawal at power		-Prolonged withdrawal of a control rod from the core at both nominal and low power -Prolonged withdrawal of a bank of control rods at both full and low power
11.3		Inadvertent control rods insertion	Inadvertent insertion of control rod or rods		Control rod drop, including the absorber part of short rods falling out of the core
11.4			Detected fault in reactor protection system		
11.5			Core instability		
11.6			SLCS inadvertent injection		
11.7				Loss of regulation	
11.8				Dual failure of group controllers	
11.9				Dual failure of data highways	
11.10				Dual failure of channel A device controllers	
11.11				Dual failure of channel C device controllers	
11.12				Loss of reactivity control	

Code	PWR	WWER	BWR	PHWR	RBMK
11.13				Moderator deuterium excursion	
11.14					Voiding of the CPS cooling circuit
RSSHR - Reduction of secondary side heat removal					
12.1	Turbine trip, throttle valve closure, EHC problems	Turbine trip	-Turbine trip -Turbine trip with turbine bypass valve failure	Turbine trip	-Turbine trip -Failure of one or two turbogenerators
12.2	Generator trip or generator; caused faults	Generator trip	Generator trip	Generator trip	Generator trip
12.3	Feedwater flow instability; operator error				
12.4	Feedwater flow instability; miscellaneous mechanical causes	Inadvertent closure of feedwater pipeline isolation valve			
12.5	Loss or reduction in feedwater flow (one loop)				
12.6	Total loss of feedwater flow (all loops)	Loss of feedwater pump		Loss of MFW supply	Loss of feedwater flow
12.7	Full or partial closure of MSIV (one loop)	Inadvertent closure of main steam isolating valve	-Main steam isolation valve (MSIV) closure -Partial MSIV closure -Inadvertent closure of one MSIV		-Failure to close the MSV -Inadvertent closure of main steam isolation valves
12.8	Closure of all MSIVs				
12.9		Inadvertent closure of turbines stop or regulation valve			
12.10		Inadvertent SGs level regulation valve operation lead to SG level decrease		SG pressurization	
12.11		Inadvertent closure of SG steam line isolation valve			
12.12		Deaerator tank or pipeline leakage			
12.13		Inadvertent opening of deaerator safety valve		Low deaerator level	
12.14		Inadvertent operation of deaerator level regulation valve lead to deaerator level decrease			

Code	PWR	WWER	BWR	PHWR	RBMK
12.15			Turbine bypass or control valves cause increase in pressure (closed)		
12.16			-Feedwater heater failure -Loss of feedwater heater		Feedwater control failure
12.17		Loss of feedwater high pressure pre-heater			
RT - Reactor trip					
13.1	Spurious trips; cause unknown	Not qualified reactor trip	Spurious trip via instrumentation, RPS fault	Spurious trips; cause unknown	
13.2	Automatic trip; no transient condition	Inadvertent automatic reactor trip	Scram due to plant occurrences	Automatic trip; no transient condition	
13.3	Manual trip; no transient condition	Manual erroneous reactor trip	Manual scram; no out-of-tolerance condition		
LC - Loss of condenser					
14.1	Condenser leakage	Leakage of condenser tank or pipeline			
14.2	Loss of condensate pumps (one loop)	Loss of condensate pump		Loss of condensate	
14.3	Loss of condensate pumps (all loops)				
14.4	Loss of condenser vacuum	-Loss of condenser vacuum -Loss of circulating water	Loss of normal condenser vacuum	Loss of condenser vacuum	Loss of condenser vacuum
14.5		Inadvertent close of condensate pipeline valve			
14.6		Loss of condenser water control			
14.7		Leakage of condenser heat exchanger			
LOST - Loss of steam					
15.1	Steam line breaks	-Steam line break inside confinement -Steam line break outside confinement	Main Steam Line Break	-MSLB Inside RB -MSLB Inside TB	Rupture of steam–water communication line
15.2	Sudden opening of steam relief valves	Inadvertent opening of atmospheric steam dump valves (BRU-A)	-Inadvertent opening of TG bypass valve -Inadvertent opening of main steam safety /relief valve (stuck)		-Inadvertent opening of bypass valve -Inadvertent opening of safety relief valve
15.3		Inadvertent opening of SG safety valves			
15.4		Inadvertent opening of turbine control valves			

Code	PWR	WWER	BWR	PHWR	RBMK
15.5			Small steam LOCA		Break of the main steam duct
15.6					-Inadvertent opening of MSVs -MSV jammed open
15.7				Loss of extraction steam supply	
SSF - Support systems failure					
16.1	Total Loss of Component Cooling Water				
16.2	Loss of circulating water				
16.3	Loss of service water system	Loss of service water	Loss of service water	Loss of service water	Loss of service water supply
16.4	Total Loss of Emergency Service Water				
16.5	Partial Loss of Component Cooling Water			CCW expansion joint or line breaks	
16.6	Partial Loss of Emergency Service Water				
16.7	Loss of component cooling		Loss of Component Cooling		
16.8	Loss of ventilation	Loss of ventilation	Loss of Ventilation	-Loss of control room ventilation -Loss of distribution room ventilation -Loss of reactor building ventilation -HVAC failure	
16.9	Loss of instrument air	Loss of control air	Loss of Instrument Air	Total loss of instrument air	
16.10					Loss of intermediate cooling circuit
LOSFW - Loss of feedwater					
17.1	Feedwater line breaks	-Feedwater line break in unisolable from SG part -Feedwater pipeline break inside confinement -Feedwater pipeline isolable break outside confinement -Feedwater pipeline unisolable break outside confinement		-Symmetric feedwater line break outside RB -Asymmetric feedwater line break outside RB -Asymmetric feedwater line break inside RB	Break of the main feedwater pipeline

Code	PWR	WWER	BWR	PHWR	RBMK
CONT- Confinement/Containment					
18.1	Containment pressure problems				
LOOL - Loss of Load					
19.1			Electric load rejection		Generator load surge
19.2			Electric load rejection with turbine bypass valve failure		
FM - Fuelling machine events					
20.1				Fuel bundle in channel crushed by FM	
20.2				Failure of FM D2O supply or cooling-FM off reactor	
20.3				Failure of transfer port and transition piece cooling (fuel stuck/damaged)	
20.4					Fuel assembly jamming or breaking off during its installation in the spent fuel pool by the refuelling machine
20.5					Canister with spent fuel falling or becoming jammed in a hanging position during refuelling
20.6					Fuel assembly jamming or breaking off during its removal from the channel by the refuelling machine under reactor operational conditions
20.7					Fuel assembly falling or becoming jammed in a hanging position during its handling by the central hall crane
IFBE - Irradiated fuel bay events					
21.1				Failure of fuel cooling in irradiated fuel bay (IBF) magazine	
21.2				Loss of bay inventory into RB during irradiated fuel transfer	
21.3				Loss of IFB heat sink	
21.4				Loss of IFB inventory outside the RB	

Code	PWR	WWER	BWR	PHWR	RBMK
21.5				Loss of IFB ventilation system	
LMHS - Loss of moderator heat sink					
22.1				Partial loss of moderator heat sink	
22.2				Total loss of moderator heat sink	
22.3				All pipe failure of moderator system outside calandria	
22.4				All pipe failure of moderator system inside calandria	
22.5				Calandria drain line breaks outside the shield tank	
22.6				Moderator system leaks into GP1 RCW	
22.7				Calandria vessel failure	
SCE - Single channel event					
23.1				Calandria tube failure	
LESC – Loss of end shield cooling					
24.1				Total loss of end-shield cooling	
24.2				Loss of end-shield cooling system inventory due to pipe breaks or leaks	
UHS - Ultimate heat sink failure					
25.1					Loss of main heat sink
25.2					Loss of ultimate heat sink
GT - General Transient					
26.1	Problems with control-rod drive mechanism and/or rod drop				
26.2	Pressure, temperature, power imbalance, rod position error				
26.3			Partial loss of Reactor Vessel Level Instrumentation		
26.4			Complete loss of Reactor Vessel Level Instrumentation		
26.5			Loss of suppression pool contents		

Code	PWR	WWER	BWR	PHWR	RBMK
26.6			Increase in drywell temperature		
26.7	General transient	General transient	General transient	General transient	General transient
EXTEA - Earthquake					
27.1	Earthquake	Earthquake	Earthquake	Earthquake	Earthquake
EXTWH - Strong wind, lightning, extremely weather					
28.1	Strong wind, lightning, extremely weather	Strong wind, lightning, extremely weather	Strong wind, lightning, extremely weather	Strong wind, lightning, extremely weather	Strong wind, lightning, extremely weather

ANNEX II: QUESTIONNAIRE FOR CONSTRUCTION DATA

1. GENERAL INFORMATION

a. Reactor unit: ____________________

b. Country: ____________________

c. Name of the project/station: ____________________

d. Construction licence holder: ____________________

e. Progress of construction

- ☐ Smooth progress (without significant delay)
- ☐ Delayed significantly (more than 2 years)
- ☐ With a suspended period:

  Suspension date: ____________________

  Restart date: ____________________

  Reasons for suspension:
  - ☐ Political
  - ☐ Public resistance
  - ☐ Energy market changes
  - ☐ Economic environment conditions
  - ☐ Investor financial problems
  - ☐ Natural calamities
  - ☐ Regulatory suspension
  - ☐ Others (specify): ____________________

  Activities during suspension:
  - ☐ Project controls including consideration for project re-start
  - ☐ Retention of human resources
  - ☐ Preservation and maintenance of equipment and facilities
  - ☐ Updating for new technology and regulatory requirements
  - ☐ Preservation of project data

  Project after restart:
  - ☐ New contract with original project/design
  - ☐ New contract and modified project/design
  - ☐ Continuation of original contract

f. Investment:

Total cost (equivalent of USD): ____________________USD

2. PROJECT MILESTONES (TERMINOLOGY DEFINITIONS)

MILESTONE	Planned Date	Achieved Date	COMMENTS and reasons for delay, if any:
A. PRE PROJECT ACTIVITY			
Regulatory Licenses for construction			Delay Code: 1 2 3 4 5 6 7 8 9 0
Contract Effective Date			Delay Code: 1 2 3 4 5 6 7 8 9 0
Start ground-breaking			Delay Code: 1 2 3 4 5 6 7 8 9 0
B. CONSTRUCTION			
1st Concrete pouring (Reactor Building)			Delay Code: 1 2 3 4 5 6 7 8 9 0
Placement of Reactor Pressure Vessel inside Reactor Building			Delay Code: 1 2 3 4 5 6 7 8 9 0
Completion of Primary Boundary Test (Cold Hydro)			Delay Code: 1 2 3 4 5 6 7 8 9 0

Containment Pressure Test — Delay Code: 1 2 3 4 5 6 7 8 9 0

C. COMMISSIONING

1st Hot Functional Test	Delay Code: 1 2 3 4 5 6 7 8 9 0
Fuel Loading	Delay Code: 1 2 3 4 5 6 7 8 9 0
1st Criticality	Delay Code: 1 2 3 4 5 6 7 8 9 0
1st Grid Synchronization	Delay Code: 1 2 3 4 5 6 7 8 9 0
100% Power Operation	Delay Code: 1 2 3 4 5 6 7 8 9 0
Licenses for Commercial Operation	Delay Code: 1 2 3 4 5 6 7 8 9 0

CODE	**REASON FOR DELAY**
1	Design changes
2	Quality Deficiency - Equipment deficiency
3	Quality Deficiency – Rework
4	Project Management
5	Contractual Problems
6	Financial
7	Human Resources
8	Force Majeure
9	Political Decision
0	Other

3. CONTRACTING STRATEGY

a. Type of contract:

☐ Turnkey

Name of the Main Contractor: ____________________

☐ Split Packages

Number of Contractors: ____________________

Name of Contractors – fill in the table bellow

☐ Multi Packages

Number of Contractors: ____________________

Name of the Major Contractors – fill in the table bellow

BASIC SCOPE of Contracts	Contractor Name
Design/Engineering/Design Supervision on Site	
Supply	
Construction/Erection	
Commissioning	
Plant Operation	
Training	

b. Contractor selection process

☐ Government Decision

☐ Bidding

4. MANUFACTURERS OF THE MAIN COMPONENTS

COMPONENT	Name of Manufacturer	Country
Reactor Pressure Vessel/ Calandria		
Steam-generator		
Turbine		
Generator		
Main Output Transformers		
Fuel for First Core		

5. EXPERIENCE FROM CONSTRUCTION AND COMMISSIONING WITH RESPECT TO REDUCTION OF PROJECT SCHEDULE AND IMPROVEMENT IN QUALITY

A. GOOD PRACTICES:

B. NEW TECHNOLOGY *(e.g. qualification of special processes)*:

C. ADVANCE METHODS *(e.g. modular concepts, new automatic machines, use of IT in project management)*:

DEFINITIONS:

Licence Holder *– every legal entity that is the Licence Holder for the Nuclear Power Plant Construction or Operation shall be deemed the Responsible Person by law*

Suspended Period*– a defined time of the Nuclear Power Plant Construction with "Zero Progress" in the Project Milestones*

Suspension Date *– Start Day for the Suspended Period*

Restart Date *– One Day after the Suspended Period End Day*

Turnkey contract *- a main contractor is responsible for design, construction and commissioning of the whole project and in charge of the project management (plant approach). The bulk of the capital cost as well as the risk of the project is placed with the main contractor.*

Split-package contract *- two major contract packages for nuclear and conventional islands are defined (island approach).*

Multi-package contract*– In the multi-package contract approach, potentially with several hundred contracts, the plant owner takes the major responsibility and risk associated with the project implementation (component approach).*

ANNEX III: SHORT DEFINITIONS OF PRIS KEY PERFORMANCE INDICATORS

Based on this manual it was possible to simplify key performance indicators (PI) definitions removing data element definitions and data requirements from definitions specified in the reference publication TRS-428 [1]. The relation between performance indicators and related data elements is shown on Figure A3-1.

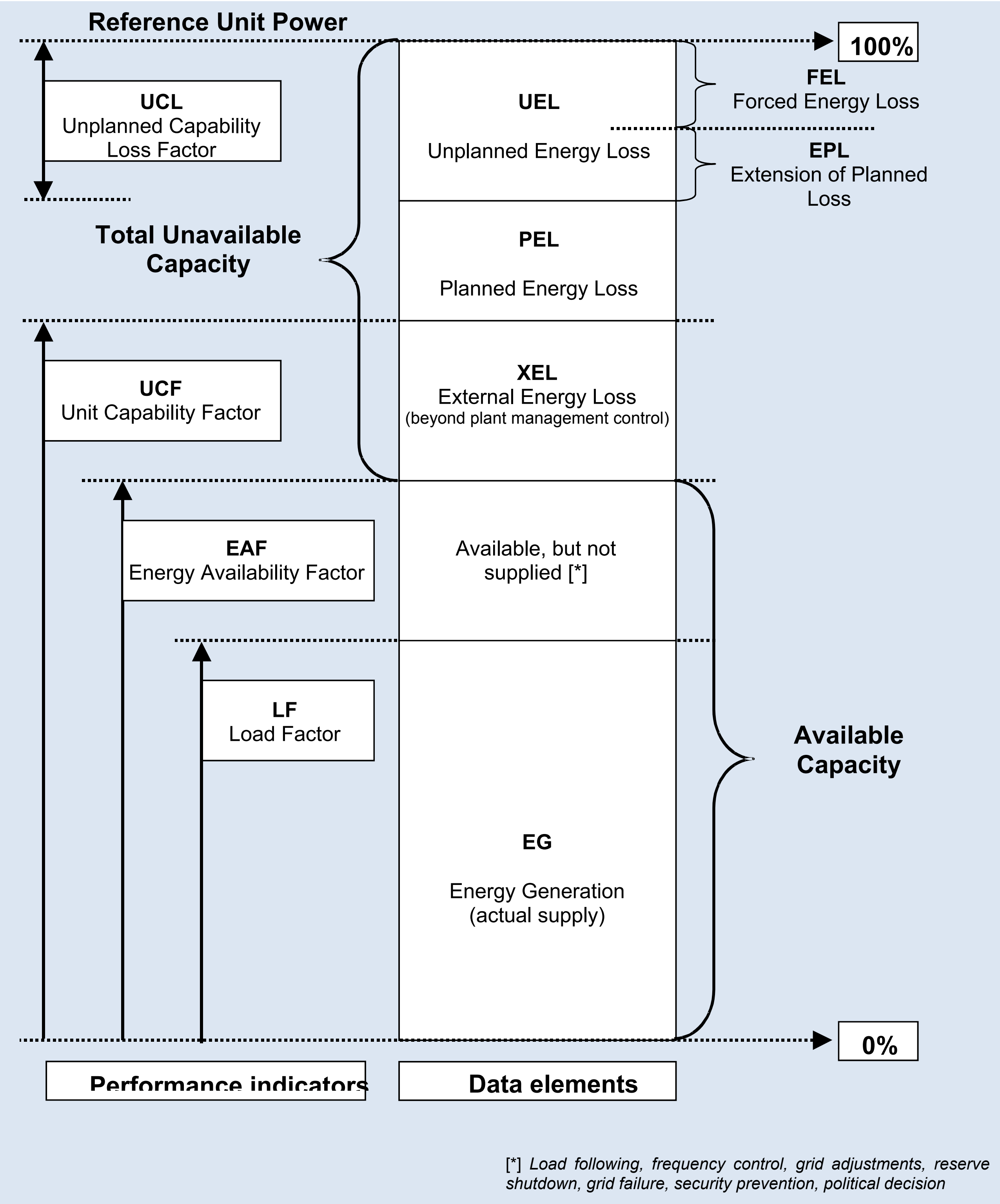

FIG. A3-1: Relations among PRIS key performance indicators.

LOAD FACTOR (LF)

PURPOSE

The purpose of this indicator is to provide the ratio of the actual electrical energy supplied to the grid compared to the reference energy generation, over a certain period of time. This indicator reflects the actual energy utilization of the unit for electricity production.

DEFINITION

Load factor, for a given period, is the ratio of the electrical energy which the reactor unit has produced over that period divided by the energy it would have produced at its reference power capacity over that period.

DATA ELEMENTS

The following data are required to calculate this indicator for each unit

- EG: actual electrical energy supplied (net) expressed in units of megawatt-hours
- REG: reference energy generation (net) expressed in units of megawatt-hours.

CALCULATIONS

The unit load factor is calculated for each period as shown below:

$$LF = \frac{EG}{REG} \times 100 \ [\%]$$

OPERATION FACTOR (OF)

PURPOSE

The purpose of this indicator is to monitor the actual time utilization of the unit with the turbo-generator set synchronized to the grid, whatever the power produced, over a certain period of time.

DEFINITION

Operation factor is defined as the ratio of the number of hours the unit was on-line to the total number of hours in the reference period, expressed as a percentage. It is a measure of the unit time availability on the grid and does not depend on the operating power level.

In some systems the indicator is called as a Time Utilization Factor.

DATA ELEMENTS

The following data are required to calculate this indicator for each unit:

- t: unit on-line hours in the reference period
- T: reference period in hours

CALCULATIONS

The unit operation factor is calculated as shown below:

$$OF = \frac{t}{T} \times 100\ [\%]$$

UNIT CAPABILITY FACTOR (UCF)

PURPOSE

The purpose of this indicator is to monitor progress in attaining high unit and industry energy production reliability. This indicator reflects effectiveness of plant programs and practices in maximizing available electrical generation, and provides an overall indication of how well plants are operated and maintained.

DEFINITION

Unit capability factor is defined as the ratio of the capable energy generation over a given time period to the reference energy generation over the same time period, expressed as a percentage.

Capable energy generation is the energy that could have been produced under reference ambient conditions considering only limitations within control of plant management, i.e. plant equipment and personnel performance, and work control.

DATA ELEMENTS

The following data are required to determine each unit's value for this indicator:

- REG: Reference energy generation, expressed in units of megawatt-hours.
- PEL: Planned energy loss expressed in units of megawatt-hours.
- UEL: Unplanned energy loss is expressed in units of megawatt-hours.

CALCULATIONS

The unit capability factor is determined for each period as shown below:

$$UCF = \frac{(REG - PEL - UEL)}{REG} \times 100\ [\%]$$

UNPLANNED CAPABILITY LOSS FACTOR (UCL)

PURPOSE

The purpose of this indicator is to monitor industry progress in minimizing outage time and power reductions that result from unplanned equipment failures or other conditions. This indicator reflects the effectiveness of plant programs and practices in maintaining systems available for safe electrical generation.

DEFINITION

Unplanned capability loss factor is defined as the ratio of the unplanned energy losses during a given period of time, to the reference energy generation, expressed as a percentage.

DATA ELEMENTS

The following data is required to determine each unit's value for this indicator:

- UEL: Unplanned energy losses expressed in units of megawatt-hours (electric).
- REG: Reference energy generation, expressed in of megawatt-hours (electric).

CALCULATIONS

The unplanned capability loss factor is determined for each period as shown below:

$$UCL = \frac{UEL}{REG} \times 100 \ [\%]$$

OPERATING PERIOD FORCED LOSS RATE (FLR)

PURPOSE

The purpose of this indicator is to monitor industry progress in minimizing outage time and power reductions that result from unplanned equipment failures, human factor or other conditions during the operating period (excluding planned outages and their possible unplanned extensions). This indicator reflects the effectiveness of plant programs and practices in maintaining systems available for safe electrical generation when the plant is expected to be at the grid dispatcher disposal.

DEFINITION

Operating period forced loss rate is defined as the ratio of the unplanned energy losses during a given period of time, considering only the operating period, to the reference energy generation minus energy losses corresponding to planned outages and their possible unplanned extensions, during the same period, expressed as a percentage.

DATA ELEMENTS

The following data is required to determine each unit's value for this indicator:

- REG: Reference energy generation, expressed in units of megawatt-hours.
- PEL: Planned energy losses, expressed in units of megawatt-hours.
- UEL: Unplanned energy losses contains two terms UEL = FEL + EPL:
  - FEL: forced energy losses
  - EPL: unplanned extension of a planned outage energy loss

CALCULATIONS

The operating period forced loss rate (FLR) is determined for each period as shown below:

$$FLR = \frac{FEL}{(REG - PEL - EPL)} \times 100\ [\%]$$

ENERGY AVAILABILITY FACTOR (EAF)

PURPOSE

The purpose of this indicator is to monitor availability of a reactor unit to supply electricity to the grid on its reference power. This indicator reflects effectiveness of plant programs and practices in maximizing available electrical generation, and provides an overall indication of how well plants are operated and maintained.

DEFINITION

The “energy availability factor” over a specified period, is the ratio of the energy that the available capacity could have produced during this period, to the energy that the reference unit power could have produced during the same period.

The energy that the available capacity could have produced is: REG – PEL – UEL – XEL

DATA ELEMENTS

The following data are required to determine each unit's value for this indicator:

- REG: reference energy generation (net), expressed in units of megawatt-hours
- PEL: planned energy loss expressed in units of megawatt-hours.
- UEL: Unplanned energy loss expressed in units of megawatt-hours.
- XEL: Externally caused (beyond the plant management control) energy loss expressed in units of megawatt-hours.

CALCULATIONS

The energy availability factor is determined for each period as shown below:

$$EAF = \frac{(REG - PEL - UEL - XEL)}{REG} \times 100\ [\%]$$

Energy Unavailability Factor (EUF): Energy unavailability factor can be calculated from the relationship: EUF = 100 - EAF over a specific time period

EUF is a composition of following factors: EUF = PUF + UUF + XUF

Where:

PUF	= planned energy unavailability factor
UUF	= unplanned energy unavailability factor due to causes in the plant
XUF	= unplanned unavailability factor due to causes external to the plant

SCRAM RATE

UNPLANNED AUTOMATIC SCRAMS PER 7000 HOURS CRITICAL (UA7)

UNPLANNED SCRAMS PER 7 000 HOURS CRITICAL (US7)

PURPOSE

The purpose of the unplanned automatic/total scrams per 7 000 hours critical indicator is to monitor performance in reducing the number of unplanned automatic/manual reactor shutdowns. The indicator provides an indication of success in improving plant safety by reducing the number of undesirable and unplanned thermal-hydraulic and reactivity transients requiring reactor scrams. It also provides an indication of how well a plant is operated and maintained.

Taking into account the number of hours that a plant was critical provides an indication of the effectiveness of scram reduction efforts while a unit is in an operating condition. In addition, normalizing individual unit scram data to a common standard (7 000 hours critical) provides a uniform basis for comparisons among individual units and with the industry values.

DEFINITION

The indicator is defined as the number of unplanned automatic/manual scrams (reactor protection system logic actuations) that occur per 7 000 hours of critical operation.

DATA ELEMENTS

The following data are required to determine each unit's value for this indicator:

- AS: number of unplanned automatic scrams while critical
- MS: number of unplanned manual scrams while critical
- CH: number of hours of critical operation

CALCULATIONS

The unit and industry values for this indicator are determined for a period as shown below:

$$UA7 = \frac{AS}{CH} * 7000$$

$$US7 = \frac{(AS + MS)}{CH} * 7000$$

DATA QUALIFICATION REQUIREMENTS

The unit must have at least 1000 critical hours per year. Requiring this minimum number of critical hours reduces the effects of plants that are shut down for long periods of time and whose limited data may not be statistically valid.

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