PALO VERDE
NUCLEAR GENERATING STATION

HVAC Training

Classroom Lesson

HVAC Training	**Date: 2/9/2011 9:41:06 AM**
LP Number: NMH30C000105	**Rev Author: Ron Newell**
Title: Chiller Maintenance	**Technical Review:** Williams, Donnell L(Z08141) Digitally signed by Williams, Donnell L(Z08141) DN: cn=Williams, Donnell L(Z08141) Reason: I have reviewed this document Date: 2011.02.17 10:18:25 -07'00'
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INITIATING DOCUMENTS

15DP-OTR69 Training and Qualification Administration

Training Program Description for HVAC Maintenance

ACAD 02-001 The Objectives and Criteria for Accreditation of Training in the Nuclear Power Industry

REQUIRED TOPICS

TCSAI# 2874669 CRDR# 2850439 THREAD SEALER ON CHILLER 1MECBE01 GUIDE VANE SHAFT

TCSAI# 2947906 CRDR# 2934843 (U-2) ON 10/23/06 AT APPROXIMATELY 0624, ESSENTIAL CHILLER "B" TRIPPED ON LOW OIL PRESSURE. DECLARED "B" CREATCS INOPERABLE.

CONTENT REFERENCES

CRDR 54077 (2-9-0094), A faston connector was found cracked on Chiller "A" (TCS 01-1693)

DMWO# 00854746 Replace Chiller Control Panel with PIC

EPA Section 608 Clean Air Act and 40 CFR, Part 82, Protection of Stratospheric Ozone; Refrigerant Recycling

Palo Verde Standards and Expectations

13-EN-306 Installation Specification for Cable Splicing and Termination

VTD-H158-0004 HENRY VALVE COMPANY PRESSURE RELIEF VALVES ASME NB CERTIFIED CAPACITIES [PUS. # BP 116].

VTD-C150-0030 CARRIER HERMETIC CENTRIFUGAL LIQUID CHILLERS STARTUP, OPERATIONS AND MAINTENANCE INSTRUCTIONS FOR MODEL 19FA467C-1816 (REVISION D) [PUB. # 19FA-2SS]°

VTD-J010-0005 JAMESBURY INSTALLATION, MAINTENANCE & OPERATING INSTRUCTIONS EJS0, EJX50, EJ90t AND EJX90 ELECTRIC VALVE ACTUATORS [PUB. # IMO-48].

VTD-J010-0023 JAMESBURY INSTALLATION, MAINTENANCE AND OPERATING INSTRUCTIONS FOR EJ/EJX (MODEL G) ELECTRIC ACTUATORS [PUB. # IMO-49].

WO Task# 069215 Perform maintenance on essential chiller.

WO Task# 092726 Perform inspection/rework of chiller internals and replace PVS.

CRDR 110846 Oil leak on the essential chiller at the oil cooler inlet. (TCS# 03-0082)

OE 11587 - Failure of Control Room Ventilation System Chillers (TCS# 00-0648)

CRDR 2553858 Several Normal chillers have tripped recently due to low lube oil pressure. DMWO to change the oil sump temperature setpoint from 145°F ± 5°F to 155°F ± 5°F. (TCS# 03-0081)

OE15289 - Freon sprayed out of chiller valve due to delay in executing work (TCS 03-0121)

Electrical Safe Work Practices 01DP-OIS13

CRDR 2687930 -(U-2) AN OIL LEAK HAS BEEN IDENTIFIED ON THE "B" ESSENTIAL CHILLER. TSC 2691522.

CRDR 2631597. The oil used to trim the level of the normal chillers was contaminated with water.

CRAI 2632787 The HVAC shop took an action to purchased and dedicate oil addition equipment for each type of oil used for the Normal Chillers (ie pumps, hoses).

CRDR 2550482 Oil sump temperature high on 1MECBE01 Chiller.

CRDR 2689093 Low oil level caused low oil temperature on 2MECBE01.

CRDR 2553858 Several of the normal chillers have tripped due to low lube oil pressure.

CRDR 2421005 Oil leak caused by a loose clamp on an oil line support.

CRDR 2583691 High lube oil tin concentration on chiller 2MWCNE01B (TSC 2674280, TCSAI 2732229)

CRDR 2707271 (U-2) engineering notes anomalies identified while monitoring bearings on chiller 2MWCNE01B.

OE19424 - Repair and Installation of Centrifugal Chiller CUNO Filters (TCS # 2756519)

OE 18597 Junction box cover installation tripped a chiller.

CRDR 3409841 B normal chiller tripped on low oil pressure, due to closed ball valve on oil filter line,

33MT-9EC01 Essential Chiller

LESSON PLAN REVISION DATA

Feb 09, 2011	Ron Newell	Added operating experience from CRDR 3409841

Tasks and Topics Covered

The following tasks are covered in Chiller Maintenance :

Task or Topic Number*	**Task Statement**

Lesson: Chiller Maintenance

CHL111	Change oil filter
CHL112	Change filter/dryer
CHL118	Inspect refrigerant safety relief valve
CHL119	Install refrigerant safety relief valve
CHL121	Remove refrigerant safety relief valve

Total task or topics: 5

TERMINAL OBJECTIVE:

1 Given the applicable work instructions, reference documents, and M&TE the trainee will, perform various maintenance activities on the Carrier 19FA Centrifugal Chiller. Mastery will be demonstrated by class participation, and successfully completing a written examination with a minimum score of 80%.

1.1 Discuss lessons learned from selected Operating Experience and CRDRs associated with performing chiller maintenance activities.

1.2 Discuss the sequence of work to coordinate chiller maintenance activities.

1.3 Discuss the process of control panel and field wiring inspection.

1.4 Discuss the process of measuring oil heater wattage.

1.5 Discuss the process for changing the oil filters.

1.6 Discuss the process for changing the refrigerant filters.

1.7 Discuss the process of inspecting and replacing the refrigerant PSV's

Course Introduction

In this course the HVAC Trainee will learn how to perform chiller maintenance on the Normal and Essential chillers.

It is everyone's responsibility to perform their work safely. Ask yourself before starting the job these Prevent Event questions…….…….….…….

I. Pre-Job Brief

A. Focus On Five (Task Preview)

Familiarize worker with the scope of work, task sequence, and critical steps.

1. Tasks (Course Terminal Objectives)
   In this course the HVAC Trainee will learn how to perform chiller maintenance on the Normal and Essential chillers.

2. Identify error likely situations (error traps)

   a. Discuss at least one specific error likely situation.

3. Identify the Worst thing that can happen.

4. Identify specific error prevention defenses to be used.

5. Identify actions to assure proper configuration control.

B. Schedule

1. Length of class

2. Break policy

   a. Two Minute Drill – After lunch at a minimum

3. Evaluation

4. Post training critique

C. Qualification

1. Identify what they will be qualified to do upon completion of the course

2.

Classroom safety

What hazards are present in the classroom?

Evacuation route

Fire extinguishers/phone

Prior to conducting any activities that have not been discussed during this Pre-job, we will use our Prevent Events tools to redirect our focus on the current scope of the task.

Is my training and are my qualifications up-to-date?

The prerequisites to this training are:

Electrical Safe Work Practices or Electrical Safe Work Practices for Non-electrical Personnel

NMH29, Chiller Fundamentals.

<u>Course Agenda</u>

NMH30 - Chiller Maintenance and Calibration

<u>Lessons:</u>

Chiller Maintenance

Calibrate Chiller Controls & Indicators

Chiller High Voltage Motor Terminals

Calibrate Flow transmitter and ratemeters

Evaluations:

Written Evaluation

Laboratory Practical – Calibrate Controls

Laboratory Practical – Calibrate Agastat Relays

Laboratory Practical – Motor Terminal

Qualification Requirements

NMH30 - Chiller Maintenance and Calibration (Initial Training)

JQC - NMH0100051 Chiller Maintenance and Calibration

JQC - Calibration of the Cooler water low temperature switch (recycle) on a Power Block Chiller

NMH15 – Chiller Maintenance Retraining (Retrain 39 mths)

TO: 1 **Given the applicable work instructions, reference documents, and M&TE the trainee will, perform various maintenance activities on the Carrier 19FA Centrifugal Chiller. Mastery will be demonstrated by class participation, and successfully completing a written examination with a minimum score of 80%.**

EO: 1.1 Discuss lessons learned from selected Operating Experience and CRDRs associated with performing chiller maintenance activities.

Introduction

The weekly PM is a valuable tool to monitor chiller overall condition and performance. Many of the corrective maintenance activities are first identified when performing the weekly PM.

In this objective we will discuss lessons learned from selected Operating Experience and CRDRs. The students are encouraged to provide any additional details if known.

Main Idea

This is a good opportunity to discuss any issues that occur when performing the weekly PM and CM activities on the chillers. Class participation is encouraged.

A prerequisite to the weekly chiller PM task is to record the last entries for refrigerant level and oil inventory on the logs. Attention to detail transferring data, oil and refrigerant levels transferred from week to week have had some errors in the past which have resulted in a chiller becoming in-op.

CRDR # 2707508 Documents the occurrence of high oil level on Normal Chiller 2MWCNE02.

The description of the event:

In Unit 2 on 5/9/04, Normal Chiller WCN-E02 was noted to be running at its upper amp limit (47amps). The chiller was secured, and HVAC responded to investigate. About 5 gallons of excess oil was removed from the chiller oil sump to bring the oil into the upper site glass. This action was taken under the weekly chiller PMWO. The chiller was placed back in service and the amps were significantly reduced (30 amps).

Details of the event:

The technician drained oil from the chiller sump because he could not see an oil level in the site glass. Once the oil level was visible in the upper site glass, the chiller amps and the oil sump temperature returned to normal. No other problems were noted concerning the operation of the Unit 2 E02 chiller. Five gallons of oil was removed from the oil sump, leaving a total oil volume accounting in the chiller at 8 gallons.

The oil volume data for chiller 2MWCNE02 in IPDAS was reviewed to identify any abnormal trends. Oil volume data back to January 2000 was reviewed. The total oil volume in this chiller varied slightly during the years. There was no indication that the chiller was using excess oil in the recent past.

A total volume of 8 gallons of oil in the chiller seems a little low for a chiller with the oil level in the upper portions of the upper site glass. It may be possible that the oil volume accounting for this chiller may not be correct. A contributing factor may have been the condition of the chiller bull's eye type site glasses to prevent identifying a problem before it caused a problem. It has also been reported that the upper and lower oil sump site glasses are scratched, cloudy, and difficult to read.

CMWO 2686282 was issued to replace the oil sump site glasses and the work was scheduled to start on July 19, 2004. The refrigerant will be transferred to the storage tanks and the oil in the sump removed under this work order. CMWO 2686282 will reset the chiller oil inventory on chiller 2MWCNE02 so the total oil volume in the chiller needs to be documented in the weekly chiller log for the future.

A note has been added to the cover page on the work order that this work order is a disposition document for CRDR 2707508.

Another issue concerning chiller oil was documented in **CRDR# 2631597. The oil used to trim the level of the normal chillers was contaminated with water.** The oil is stored in the five gallon buckets on the aux roof of each unit. Once the five gallon containers are opened the oil starts to get contaminated with moisture.

CRAI #2632787 documents that the shop took an action to purchased and dedicate oil addition equipment for each type of oil used for the Normal Chillers (ie pumps, hoses). Additional flame cabinets were purchased for each aux roof to store the oil and equipment in. The plan was to use one gallon containers to transport and store the chiller oil.

Ask the students to provide feedback on the success of this CRAI.

Logging the chiller readings should be more than just looking at the temperature and pressure indicators and recording a value. This is a performance check of the chiller when it is operating and a verification of it's readiness when it is shutdown.

What could cause the oil temperature/level to be out of spec?

CRDR # 2550482 documents an occurrence of the oil sump temperature high on 1MECBE01 Chiller.

The description of the event:

The Area 4 Operator found the essential chiller 1MECBE01 oil sump temperature high outside the normal band at 159 °F (normal band is 130 - 150 °F) on August 27,2002.

Unit 1 was in an "A" Train work week with A train aux feedwater INOPERABLE. The EC chiller lube oil pump was started manually and oil temperature decreased to within spec.

Details of the event:

We have experienced problems with the lube oil heater temp controllers in the past. 200 °F has been used as a "cut-off" temperature to evaluate whether lube oil lubrication ability could be subject to premature breakdown.

The temperature controller (1JECATC0518) for the EC chiller oil sump heater has some history of the set point drift. There has been several work orders issued to adjust the controller. A search of SWMS found less than ten work orders that actually replaced a temperature controller.

On 08/04/02 a similar condition occurred on the Unit 1 "A" Chiller reference CRDR 2546696.The oil temperature controller (1JECATC0517) was replaced.

Several CRDRs have been issued because of high lube oil sump temperatures. Operability Determination # 94 was issued in 1996 to address the impact of high temperature on the EC lube oil. The concern with high lube oil temperature is of a "long term" nature rather than an immediate OPERABILITY concern.

This OD has been used several times over the years to justify operability of the chillers. The OD has buffered the impact of finding the oil temperature outside of the normal temperature band.

The impact on plant operations has been minor for the majority of the times the temperature was found outside of the normal control band. HVAC Maintenance has been able to replace the erratic controller that fails to return to the normal control band. When the controller becomes intermittent, like 1JECBTC0518, a work order written to replace the instrument as scheduled maintenance.

Fenwal temperature controllers are available on the market and the procurement lead time is relatively short. A clearly declining trend has not been identified. There are no current plans to replace the Fenwal controller with a different instrument because of performance problems.

CRDR # 2689093 documents an occurrence of low oil level which also caused low oil temperature on 2MECBE01.

The description of the event:

On March 8, 2004 the Essential Chiller "B" was found with no visible oil level and oil temperature out of specification low at 106 degrees. Minimum operability limit is 120 degrees.

Declared EC "B" INOPERABLE and complied with LCO 3.7.10.A. No visible oil leak was apparent on the chiller skid. 1.5 gallons of oil was added to bring the level up to 3/4 of the lower sight glass and the chiller was restored to OPERABLE status at 0143 on March 9, 2004.

Details of the event:

Due to the reactor being shutdown for maintenance the "B" essential chiller had been operated at a low load condition for several days. Oil had been added to the oil sump several times during this time. When the chiller was secured following reactor startup, it was not noticed that the oil level was below the bottom of the lower site glass. Operating the chiller at low loads for extended periods will cause oil to be entrained in the refrigerant and accumulate in different parts of the chiller. The low indicated level does not represent a loss of oil in the chiller. When the chiller is run with sufficient load the oil will be recovered.

Previous evaluations established a low oil level limit of "visible in the sight glass" although the chiller will operate as long as the oil pump can supply above 13 pounds of pressure. There is no way to visually identify the actual level in the sump below the lower site glass. The bottom of the lower sight glass equals 6.5 gallons of oil in the sump. The bottom of the sump is 12 inches below the sight glass. At 0.625 gallons per inch, the as left level was 12.75 inches and the as found level was 10.35 inches. The suction of the oil pump is located approximately 1 inch above the bottom. With 9.35 inches of oil above the suction the oil pump would have easily provided the necessary 13 pounds of pressure. The chiller would have performed its safety function.

Oil temperature gauge 2JECBTI0512 was reading 106 degrees F. The ¼ inch diameter stem of the temperature gauge is mounted in the oil sump through a wet well that is even with the bottom of the lower site glass on the chiller sump. It is likely that the temperature gauge sensing element was not immersed in oil because the oil level was below the sensing element. The oil temperature indicator was measuring the temperature of the free space above the oil and not the oil temperature because the sensing element was not in the oil.

The oil sump temperature controller 2JECBTC0518 is mounted through a drywell in the oil sump. The bottom of the oil sump temperature controller is about one inch below the bottom of the lower oil sump site glass. The oil temperature controller was still immersed in oil based on the volume of oil added to the sump to bring the visible oil level to 75 % of the lower site glass. The temperature controller was controlling the oil sump between 140 and 150 degrees F. A review of the weekly chiller logs for the essential chillers in all three units was conducted. The present oil levels and the total oil volume inventory in each essential chiller are acceptable.

Conclusion:

Operating the essential chillers at low load and low condenser cooling water temperatures for an extended period of time is vary hard on the chillers. Problems such as refrigerant stacking and loss of oil level in the sump to other area in the chiller have been addressed in the past at Palo Verde. Installation of the refrigerant head pressure control valve (RHPCV) has greatly reduced the number of times that the essential chiller were in a condition of low oil levels by throttling the condenser water flow during low loads and low cooling water temperatures. The operating procedures provide guidance to Operations personnel to place a load on the chiller if it must be run for extended times under low loads. However, we know there will be times that we will have to operate at low loads to support normal plant operations. The key is to recognize these times and manage the situation.

This event was discussed with System Engineering and the HVAC Maintenance personnel. No new issues were raised during the review of this event. Being mindful of plant conditions and the effect on the running chiller is important. No other actions have been identified during this adverse CRDR evaluation.

CRDR 2553858 Documents that several of the normal chillers have tripped due to low lube oil pressure.

The description of the event:

There is an increasing trend for the normal chillers to trip when the chillers are started after being in standby for a while. The chillers start normally and then trip due to a low oil differential trip after a few minutes of operation.

History:

The 800 Ton 19FA Carrier chillers were converted from R-12 to R-134a over the last few years under DMWO # 218621. The last chiller conversion was completed early in 2002. The mineral oil used in the chillers was replaced with a synthetic polyol ester (POE) oil that is compatible with the new refrigerant.

There is noticeably more foaming when pulling an oil sample from a machine with the new POE oil. The oil sample is cold to the touch even though the sump temperature is above 140°F. There are times when we have noticed that the oil differential pressure fluctuates on chiller startup and settles out after several minutes of operation. Pressure fluctuations are attributed to refrigerant absorption in the oil.

Normal chiller 1MWCNE01C has been converted to R-134a and later had a modification that installed a new microprocessor control panel (DMWO # 219505). Carrier made the microprocessor control panel for the R-134a machine with the oil controller set between 150°F and 160°F in the program scheme. We have seen less forming of the oil in the Unit 1 C chiller because of the higher temperature.

Normal chiller 1MWCNE01C has been in operation with the new control panel for about two years. A review by Palo Verde's Lube Engineer found that there has been no difference in the oil samples from all the normal chillers during this time. There is no indication that elevated sump temperature has a negative impact on the POE oil. Raising the normal chiller sump temperature to control between 150°F to 160°F should help drive the R-134a refrigerant from the POE oil as it sits in the chiller sump as well as reduce the number of nuisance trips due to oil pressure differential. This will also ensure the chiller lubricating system delivers the needed lubrication to the chiller bearings during initial startup and while operating.

DMWO # 2569741 changes the oil sump temperature setpoint from 145°F ± 5°F to 155°F ± 5°F. This change will be implemented on the 800 Ton normal chillers 13MWCNE01A, B, and 23MWCNE01C.

This modification will require two adjustments.

Change the oil sump temperature setpoint:

The setpoint change requires the chiller to be shutdown while the controller is being adjusted.

Remove the cover from the oil sump temperature controller.

Adjust the oil sump temperature setpoint to 155°F ± 5°F.

Verify that the oil sump temperature controller is cycling the heater on and off to maintain temperature.

Adjust lube oil cooler temperature control valve:

The control valve adjustment will require the chiller to be in operation while the oil cooler outlet throttle valve is adjusted to the higher temperature range.

Remove the administrative control lock on the oil cooler outlet valve.

Adjust the oil cooler outlet valve to maintain oil sump temperature 155°F ± 5°F.

Replace the administrative control lock on the oil cooler outlet valve.

<u>What could cause the chiller to trip on low oil pressure?</u>

CRDR# 2934843 Document an occurrence of a U-2 Essential chiller trip due to restricted oil flow.

On October 17, 2006, HVAC had completed maintenance on 2MECBE01, Essential Chiller and returned the Chiller to Operations. This maintenance included replacement of the oil pump filters.

Two filters are utilized on the oil pump. They are installed in tandem (i.e. one stacked on top of the other). Loose woven felt gaskets are placed on the top and bottom of each filter. The filters are inserted into the filter canister and rest on top of a spring. A cone shaped tube slightly protrudes down from the mounting area; this assists in aligning the upper filter and gasket onto the mounting area. Once aligned the technician must exert upward pressure, to overcome the spring tension, while sliding the filter canister over the O-ring seal and hold the filter canister housing against the mounting area. Next the technician must screw on a collar to secure the assembly in place. Access to this work area is restricted; piping and supports hamper access and obscure the technician vision.

On October 23, 2006, the Essential Chiller 2MECBE01 tripped on low oil pressure. Operations generated work order 2934841 to troubleshoot and rework.

On October 23, HVAC performed troubleshooting. Initial problem indication was possibly a loose connector but after tightening the connection and running the pump; the amp draw was too high. The decision was made to replace the oil pump.

The oil pump was replaced on October 24 and the chiller was run again. Amp draw was still high. Further checking revealed a high Differential Pressure [DP] across the filters. When the filter canister was removed they found the upper felt gasket was half wedged in the filter housing discharge line. The old filters and gaskets were replaced with new filters and gaskets. The chiller was re-run and acceptable amp draw reading were obtained.

Evaluation of the removed filter revealed a depression on the upper filter. This depression was determined to have been caused by the discharge line tube; the upper filter was misaligned to the discharge line during assembly allowing the gasket to be slowly extruded from its installed location and enter the discharge line; restricting oil flow.

Filter and gaskets were replaced by WO 2934841. Chiller was returned to service with no further problems.

<u>What could cause the refrigerant level to be out of spec and what actions are required?</u>

CRDR #2711310 documents an occurrence when the refrigerant level was less than the minimum operability level.

Description of event:

Operations was notified by HVAC that during the performance of PM Task # 2615486 that the refrigerant level was less than the minimum OPERABILITY level (3 3/8 inches). This notification resulted in the control room conservatively declaring (U-3) Essential Chiller B INOPERABLE(due to the words MINIMUM OPERABILITY LEVEL). This also cycled the control room and engineering to determine and define what is the minimum acceptable refrigerant level for OPERABILITY. The wording in the PM needs to be changed from MINIMUM OPERABILITY LEVEL to MINIMUM OPERATING LEVEL. The minimum level for operability is defined in 40OP-EC01/2 Visible level in the sight glass. The PM does provide the required action to regain the operating band refrigerant level by running the chiller until readings stabilize and shutdown the chiller and take readings 4 hours after shutdown. It also requires notification of the operations, maintenance engineering, and HVAC WGS.

Evaluation

In 1998, CRDR 9-8-1324 evaluated the correct chiller refrigerant charge and determined the sight glass level based on that charge. A minimum charge of 1686 pounds is based on a test performed by the vendor to remove the design basis heat load. The minimum operability level is based on this charge of 1686#. Refrigerant tends to condense in the coldest part of the machine and is affected by relative temperatures of the EC and EW systems. Depending on these conditions, all of the refrigerant may not return to the evaporator and therefore cause a low sight glass level that is not indicative of the actual refrigerant charge. An additional 100 pounds of refrigerant was added to provide a margin of safety and to allow for changes in indicated level. This is considered the “high normal operating level”. Because of the these changes in relative temperatures, the indicated level will not always remain above the minimum operability level and does not, in-and-of itself, mean the charge is low. To get the most accurate level representation of the chiller charge, the machine needs to be run, then placed back in stand-by and allowed to set until the indicated level stabilizes. All available steps have been taken to minimize the indicated level fluctuations (refer to CRDR 1-8-0286). Increasing the margin to something greater than the current 100# will adversely affect its heat removal capability.

The disposition of CRDR 9-8-1324 requires the HVAC documents to be changed, including the PM tasks referenced in this CRDR, to use the term “Minimum Operating Level”. The current EC System engineer, Tom Matlock, was consulted on this issue and feels the term is accurate as written.

The Operating Level in 40OP-9EC01 that the originator refers to is in step 5.3.7 and is with the chiller running, not in the stand-by condition that the PM requires. Refrigerant level will change with chiller load and can not be accurately determined with the machine OPERATING. Therefore the term “Visible in sight glass” was used for operator verification. The term “Minimum Operating Level” would not be accurate for the 3 3/8” sight glass level in the Stand-by Mode that the weekly task requires and, as a result, can not be changed as requested by the originator.

The PM task (refer to WO2615486) provides the machine parameters in the “Specified Ranges” section. Under the Refrigerant High/Low levels is a note that states “See Note #1” Note 1 directs the steps that should be taken if the level is found either high or low and are in the following order:

1. run the chiller until the readings have stabilized, shut down for 4 hours and reread level.
2. If the refrigerant level is in range, no additional work is required.

3. If the refrigerant level remains out of range notify Operations, Engineering and HVAC for additional direction.

The intent is to insure an accurate level is obtained prior to making an operability or corrective action decision. However, operations is required to be notified and requested to run the chiller. At this point a member of operations may decide to take a conservative approach and declare the chiller in-operable until proven otherwise. This is always their option but is not the intent of the task. To insure the intent of the steps is clear for the Control room staff, a pri 4 action has been generated to enhance the existing statement in the task to state something to the effect; “Sight glass level may not be and accurate indication of the chiller refrigerant charge due to stacking. The following steps should be performed prior to determining necessary corrective actions or chiller operability.”

Evaluation Conclusion

There words in the task are written as directed by CRDR 9-8-1324. The necessary steps to verify level prior to making corrective action notifications are correctly identified in the instructions. The STA made a conservative decision to declare the Chiller inoperable prior to performing these steps and has every right to do so.

The discrepancy between the Operability level listed in the task and the 40OP are due to the stand-by vs. operating conditions when the readings are required to be taken. The conditions described in this CRDR were not the result of a Human Performance Error.

An action has been generated to enhance the recommendations to perform the steps necessary to validate the sight glass level prior to determining operability.

I request this CRDR be closed based on the evaluation performed and the Note worthy HP Event Criteria 5 requirements be removed.

Cause

Possible misunderstanding of how sight glass indications can change without loss of refrigerant and that it should be validated prior to making an operability determination. If it was understood, a conservative decision to declare the chiller in-op until proven otherwise is and will remain to be at the discretion of the control room staff.

To insure the intent of the steps is clear for the Control room staff, a pri 4 action has been generated to enhance the existing statement in the task to state something to the effect; “Sight glass level may not be and accurate indication of the chiller refrigerant charge due to stacking. The following steps should be performed prior to determining necessary corrective actions or chiller operability.”

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STA made a conservative decision to declare the Chiller inoperable prior to performing these steps and has every right to do so.

The discrepancy between the Operability level listed in the task and the 40OP are due to the stand-by vs. operating conditions when the readings are required to be taken.

Action Plan

A pri 4 action has been generated to enhance the recommendations to perform the steps necessary to validate the sight glass level prior to determining operability.

Enhance the statement in the Essential Chiller weekly tasks to insure the steps to run the chiller should be taken prior to determining operability and/or corrective actions is understood by the technicians and Control room staff. It should say something to the effect; “Sight glass level may not be and accurate indication of the chiller refrigerant charge due to stacking. The following steps should be performed prior to determining necessary corrective actions or chiller operability.”

<u>The weekly PM is the time to look over the machine and identify any abnormalities.</u>

Area Operators also perform rounds to evaluate the operability of the chillers.

Review the following examples and discuss the possibility of a reoccurrence.

CRDR #110846 (U1) documents an oil leak identified on the "B" Essential chiller due to the elbow fitting at the oil cooler inlet.

Description of event:

During Area Operator rounds an oil leak was identified on the "B" Essential Chiller on the elbow fitting at the oil cooler inlet. With the oil pump running, the leak is approximately 2 drops per second. Although the chiller is considered operable based on the ability to add oil as necessary to make up for the leakage, an Operability Determination # 231 is being initiated to formally evaluate the potential operability impact.

HVAC personnel will be quantifying the leakage to determine the expected duration between oil additions. The EC Maintenance Engineer (W. Leaverton) was contacted and concurred with these conclusions. A drip catch has been placed to prevent oil puddle beneath chiller and Work Request 967147 has been initiated.

BACKGROUND

On 10/28/99, the elbow on the inlet line to the oil cooler on essential chiller 1MECBE01 was removed and reinstalled (under Corrective Maintenance Work Order 00889903) in an attempt to eliminate an oil leak in the line. During the performance of this work, the technician had difficulty removing the elbow from the oil cooler. After repeated attempts, the technician was finally able to remove the elbow. In the process of removing the elbow, however, an excessive amount of torque was applied and the elbow was damaged.

Unaware of the damage, the technician reinstalled the elbow and retested the installation. The retest was satisfactory and the chiller was returned to service. On 11/07/99, Operations personnel observed that the inlet line to the oil cooler was leaking once again. Engineering and Maintenance personnel inspected the leak, and it was concluded that the leak was emanating from the inlet elbow, which was damaged. The damaged elbow was replaced on 11/19/99 under Deficiency Work Order 00903980. To facilitate the work, the existing union and pipe nipple that are adjacent to the elbow were also replaced. The installation was retested satisfactorily and the chiller was returned to service.

EVALUATION

The crack in the elbow on the inlet line to the oil cooler of essential chiller 1MECBE01 was caused by excessive torque that was applied to the elbow during the implementation of CMWO 00889903. The elbow was replaced in an expedient manner. In the period between the discovery of the oil leak and the replacement of the elbow the quantity of the oil leak was measured closely. At no time did the oil leak reach the point where it would impact the operability of essential chiller 1MECBE01 (reference Operability Determination #231).

CRDR #2421005 documents an oil leak caused by a loose clamp on an oil line support.

The loose clamp allowed the line to rub on the bracket until a small hole to develop causing oil and freon to leak. The oil line was replaced and the bracket secured.

CRDR3 2687930 - Documents an oil leak being identified on (U-2) "B" Essential chiller

On March 3, 2004. During routine maintenance activities, an HVAC maintenance technician discovered oil on the floor under the 2M-ECB-E01 Chiller.

Tracking the path of the oil residue, it appears that the oil is originating from the discharge temperature sensor component compartment.

The leak was found to be the a RobertShaw temperature sensor model ES11-3000 series immersion type resistance temperature detector (RTD). The leak was located where the wires exit the element. The amount of oil was estimated to be approximately 4 ounces.

Cracks in the sensing element for the refrigerant discharge temperature have shown up in some of the large normal chillers. This is the first time a leak of refrigerant and oil has been identified due to a leak around the epoxy seal on the refrigerant discharge sensor.

System Engineering has agreed to take an action to identify a replacement sensor for the Robert Shaw sensor.

Additional lessons learned:

OE11587 documents the failure of the Control room ventilation system chiller at Oconee Nuclear Site caused by refrigerant leaks.

On March 9, 2000, with all three Oconee Units at 100 percent power, both control room chillers were declared inoperable after both had tripped. The station started to shutdown the units as required by the plant technical specifications. Refrigerant leaks were found at tubing fittings on both chillers. Refrigerant was added to both chillers and the chillers declared operable. One chiller was declared operable within three hours and the units were returned to 100 percent power. Degraded copper tubing flares at filter/dryer connections on the chillers caused refrigerant leaks. The station indicated that the root cause was insufficient detail in the maintenance procedures to evaluate the flares. A lack of effective monitoring for refrigerant loss contributed to the event. The tubing has been replaced and enhancements are planned for leakage monitoring. As a result of a previous similar event, a recommendation was made to revise operations daily rounds sheets to monitor operating parameters that would indicate proper refrigerant charge. This recommendation was not adequately communicated to operations, and therefore was not implemented.

CRDR # 2583691 documents High Lube Oil Tin Concentration on chiller 2MWCNE01B

1) Description of the Occurrence:

Lube oil analysis identified a high concentration of the metal Tin (Sn) in 2MWCNE01B oil samples. An increasing trend of the concentration of tin in the normal chiller oil samples has been identified. This CRDR to document a degrading trend and our response plan.

2) Extent of Condition / Transportability / Safety Significance:

The condition of normal chiller 2MWCNE01B was discussed with the Lube Engineer. There is a sharp rise in the tin concentrations on chiller 2MWCNE01B only. The other normal chiller tin numbers are under the 2 sigma (10 PPM Tin) line.

CRDR #2707271 documents that (U-2) ENGINEERING NOTES ANOMALIES IDENTIFIED WHILE MONITORING BEARINGS ON CHILLER 2MWCNE01B.

CRDR 2583691 has been tracking tin numbers in the oil samples from chiller 2MWCNE01B. Inspections of the bull and pinion gear bearings on normal chillers 1MWCNE01B and 2MWCNE01B found evidence of over heating. As-found clearance on the pinion gear bearing was less than minimum gap. Carbon residue on bearing surfaces. There is some evidence of copper plating out on bearing surfaces.

The bearings show ware but have not failed. However, concern has been raised about as to why the clearances have closed up and the localized overheating of the bearings.

CRDR 2850439

Thread sealer on Chiller 1MECBE01 Guide Vane Shaft Failure Description

HVAC Maintenance found one of the set screws loose on the guide vane shaft crank arm during the

performance of normal chiller maintenance on essential chiller 1MECBE01 during U1R11. The crank arm

was loose, but was not slipping on the shaft. One of three (3) set screws was found loose. The

technicians recalled a recent INPO Operating Experience report (OE) that identified a similar problem at

the Hope Creek station.

OE 21321 identified an incident at the Hope Creek station where the control linkage set screw can loosen

and allowed the crank arm to slip on the guide vane shaft. Hope Creek applied Loctite thread sealer 242

(medium strength thread sealer) to the set screw threads to help hold the set screws in place and help to

prevent the set screws from backing out.

HVAC Maintenance and Maintenance Engineering viewed the use of the medium strength thread sealer

as a good maintenance practice. HVAC Maintenance generated CMWO 2845865 to apply Loctite thread

sealer to the crank arm set screws on chiller 1MECBE01. CMWO 2846522 was generated to apply

Loctite thread sealer to the crank arm set screws on chiller 1MECAE01.

Essential chiller 1MECBE01 was returned to service following maintenance. About 36 hours after start up

the chiller tripped on low refrigerant temperature. Troubleshooting performed under CMWO 2850424

found that the guide vane actuator was not responding to the chiller demand. The guide vane linkage was

disconnected from the actuator and found to be extremely difficult to move by hand. The guide vane

linkage should be able to operate smoothly over the full range of the guide vane. The decision was made

to pump down the chiller and go in and look at the guide vane for a possible problem with the internal pulleys or cable. The guide vane actuator seemed to respond to manual control when disconnected from

the crank arm linkage.

HVAC Technicians removed the guide vane actuator linkage arm in preparation for pulling the suction

pipe spool that contains the guide vane mechanism. The technicians noticed a streak of thread sealer

from the crank arm to the bearing housing yoke for the guide vane shaft. The bearing housing yoke was

removed and the presence of thread sealer was noted on the guide vane shaft and bearing housing.

It was discovered that the thread sealer applied under CMWO 2845865 had seeped along the guide vane

shaft and into the guide vane shaft bushing housing. The thread sealer got between the guide vane shaft

and the bearing housing yoke. This caused a large drag between the guide vane shaft and the bushing

housing. The guide vane shaft was no longer free to rotate and resulted in the guide vane actuator being

unable to respond the changing system cooling demand. The apparent cause of this incident was too

much thread sealer applied to the set screw threads for the guide vane shaft which contributed to the

excess sealer being allowed to migrate along the shaft to the bushing housing.

CRDR 3409841

Unit two B normal chiller tripped on low of pressure on start up.

Closed ball valve on oil supply line was not restored after oil filter replacement.

The refrigerant was removed from the machine so there is no advantage to closing the valve to replace filters.

P.M. now have work instructions to verify the valve is opened before starting chiller.

EO: 1.2 Discuss the sequence of work to coordinate chiller maintenance activities.

Introduction

In this lesson the trainee will discuss various maintenance activities on the Carrier 19FA Chiller.These tasks are performed during the outage where coordination of the work activities is critical.

Lessons learned form OE15289 - Freon Sprayed out of Chiller Valve due to Delay in Executing Work will also be discussed.

Main Idea

1) The sequence of work activities should be determined prior to starting the job. This will ensure the most efficient use of the scheduled time. The method of restoration of the refrigerant transfer into the machine will be determined during the Pre-job briefing. Areas that should be addressed in the briefing should include but not be limited to:
   a) Leak check the chiller, refrigerant
      i) Leak check the chiller prior to transfer of refrigerant into storage tank.
      ii) Pump down requirements will be determined by the work scope.
   b) Heater calculation may be done on the front end or completed after oil change out.
   c) Calibrate non-pressure boundary controls while moving refrigerant.
   d) Simultaneous work activities are performed to save time and should not distract you from protecting the machine from freezing.
   e) Trending Refrigerant Levels
   f) Testing Methods
   g) EPA Requirements for Scheduled Repairs.
      i) EPA requires pull down to four inches of mercury for our chillers.
      ii) If we have a large leak the requirement is then 0 PSIG.
      iii) If we are only changing oil, then oil may be removed at 2 – 5 PSIG.
      iv) If we are doing major work, i.e. bearing inspections, retrofitting, or any large component opening we will pull down to 22” and then re-charge with nitrogen, which would require evacuation before re-charging with refrigerant.
   h) There have been problems in the past with a lack of communication between shifts about:
      i) when we were going to open the machine
      ii) if the machine had been back filled with nitrogen

iii) does the machine need to be evacuated

iv) what other work is planned during the outage. (CM work may have been added to the scope)

i) If we are doing minor work then we only need to go to four inches mercury. Sometimes it's required to pull down to 4 inches several times on the R – 114 machines.

j) A word of caution, care should be taken to not accidentally open the transfer valve. It's the only barrier that prevents hundreds of pounds of refrigerant from re-entering the machine.

Cautions

On EC chillers, isolation valve to automatic metrex head pressure control valve must be closed, vacuum will invert and damage diaphragm.

k) Refrigerant Transfer Valve

i) When the machine is pumped down take care not to disturb the refrigerant transfer valve.

l) Adding Chiller Oil & Draining Oil from Storage Tank

Note: The following event was covered in HVAC Industry Events class. An optional method of covering this lessons learned is to ask the trainee to recall the event and challenge them to recall the why it happened.

Lessons Learned:

OE15289 - Documents an event caused by poor communication and a delay in work that resulted in freon being sprayed out of a chiller valve.

Abstract: While attempting to remove a chiller jet pump solenoid valve for preventive maintenance (pm), freon sprayed out of the valve. The causes were determined to be an inadvertent delay in the work that allowed the freon pressure to increase and communication between the two maintenance groups involved.

1) What happened? This event occurred at Virgil C. Summer Nuclear Station on 10/01/02 when a routine PM was planned for the chiller jet pump solenoid valve. I&C supervision was informed by HVAC personnel that freon level and pressure had been sufficiently reduced to allow solenoid disassembly. The valve is not isolable from the freon flow path, so system pressure is reduced to a minimum by cooling the chiller down. The I&C technician obtained QC support and proceeded to the chiller to remove the solenoid. Approximately one hour had elapsed from the time of notification by the HVAC group to the actual start of disassembly. Based on the information received from the HVAC mechanic, the I&C technician did not check the freon pressure gage. The technician was loosening the bonnet bolts for the jet pump solenoid valve on "C" Chiller when freon started spraying from the opening. The technician and the chiller were sprayed before he managed to reassemble the solenoid valve sufficiently to stop the leak. The HVAC group was informed and they reduced freon level and pressure to allow work to continue. A small amount of freon was expelled during subsequent disassembly but the technicians were prepared for it and consequently it was not a problem.

2) Why did it happen? The causes identified in the OE

1. The I&C technician did not perform the task immediately upon isolation of the system. When the HVAC mechanic notified I&C, he did not communicate that the internal pressure would increase with time. The technician did not know the internal pressure would increase with time as the chiller heats up from the initial cool down.
2. This critical information was not covered in the pre-job briefing. The I&C technician did not communicate with the HVAC mechanic just prior to removing the solenoid and was not expecting freon to spray out when the solenoid was removed.

3) Could this type event happen at PV? What scheduling problems can the group identify that may be applicable?

Corrective actions identified in the OE.

The I&C and Mechanical HVAC maintenance groups have discussed communication protocol and awareness of possible changing conditions on plant equipment when delays in work activities occur or time is of the essence. In the future HVAC and I&C will work together on this task until the solenoid is removed. Additional means to isolate the system or a way to note the potential for freon leakage during task performance is being investigated by maintenance.

4) What could you do to prevent this from happening?

Explanation

Have the students look at the Essential PM as you cover the lesson.

EO: 1.3 Discuss the process of control panel and field wiring inspection.

Introduction

In this objective the trainee will learn what to look for when inspecting the chiller control panel and field wiring.

Main Idea

Perform a Two Minute Drill:

What are the task conditions?

1) Assess and address work place hazards.
2) Verify that the chiller control panel is de-energized.
3) Check field terminations and main control panel terminations for looseness, discolored or cracked insulation, and evidence of corrosion.
    a) Control Panel Inspection:
        i) Terminal board screws and hardware
        ii) Relay terminations
        iii) Fuse connections
        iv) Temperature module terminations
        v) Timer terminations
        vi) General condition of wire in raceways
    b) Field Termination Inspection:
        i) Sensor terminations
        ii) Termination block hardware

Lessons Learned example:

On 04/26/1999

Faston connections for the 120v power to the program timer on the Essential chiller was found to be cracked approximately 1/3 of the way across the throat of the connector. CRDR# 2-9-0094 was written to address this issue.

HVAC Technicians should always be on the look out for connectors that may be cracked.

Take care not to bend connectors while performing work in the control panel.

4) Rework per 13-EN-306 and VTM-C150-0001.
5) Due to the connections physical location, ensure the spade lug connections are tight.
6) Also check the box cover gasket condition

Good work practices:

DMWO# 854746 was written due to the frequent failures (resulting from the high heat conditions) and equipment obsolescence. Extra care should be taken when checking the wiring and connections. Although the decision has been made to replace the existing control panels for the large normal chillers it will take time before all the panels are replaced.

Demo

Demonstrate performance of the electrical terminal inspection.

Perform a hazard assessment. Ask the trainee to identify the PPE requirements for this task.

EO: 1.4 Discuss the process of measuring oil heater wattage.

Introduction

In the previous course NMH29 Chiller Fundamentals the trainee learned how to adjust the thermostat for the oil sump heater.

In this objective the trainee will learn how to check the amperage of the oil immersion heater, design heater wattage is 1000 watts.

Additionally, you will review CRDR# 2553858 Several Normal chillers have tripped recently due to low lube oil pressure. The oil sump set point changes are covered in DMWO# 2569741.

Main Idea

Time for a Two Minute Drill

Assess and address work place hazards.

You will be measuring current and voltage.

Caution - Error Likely situation!!

The oil sump heater is not powered from the Aux Power Panel.
The oil heater for the Essential Chillers is powered from the 100 ft. Control Bldg. Ess Switchgear and the Normal Chillers are powered from the 140 ft. Aux Bldg East wrap, D panel.

1) Verifying oil is present in the sump prior to energizing the heater.
2) Obtain the voltage and current values.

   oil heater volts _________ vac ________ amps

   a) calculate the heater wattage per the following:(design heater wattage-1000 watts.)

   b) P = E X I where: P = heater power in watts
      E = voltage as measured.
      I = current as measured.

      calculated heater wattage:___________ watts.

3) If the heater wattage is not per design notify HVAC for further information.

Demo

Perform a hazard assessment. Ask the trainee to identify the PPE requirements for this task.

EO: 1.5 Discuss the process for changing the oil filters.

Introduction

In this objective the trainee review the criteria for changing the oil filters.

Main Idea

Assess and address workplace hazards.

Verify the oil sump heater is de-energized prior to removing oil from the sump.

Oil filter change out.

Once the chiller pump down is complete, tag out the oil immersion heater and drain the oil sump. Record the oil removed in the weekly chiller PM.

1) Normally done with system pressure at O PSIG.
   a) Can be done without transferring refrigerant by closing valves 1 outlet oil cooler and check valve down stream of oil filters holding, use care in breaching system, bleeding oil filter housing ensuring check valves is holding.
2) Removing the filter.
   Loosen the filter holding clamp near the filter bottom.
   b) Rotate the filter nut counter clock wise using a spanner wrench or if required drive pine and hammer, tapping nut on flat flange to break nut loose, take care not to ding filter housing which can cause poor O-ring contact if damaged.
   c) Keep the filter body upright when removing in order to avoid oil spilling.
   d) Drain oil into bucket remove filters, support tubes and spring.

Motor cooling filter change out.

1) When changing out the motor cooling line filter the refrigerant must be transferred.
2) The filters for the motor cooling line are the same as the oil filter.

Oil and Motor Cooling Filter Cartridges

1) The cartridge used with the oil filter conforms to carrier specifications.
   a) Two cartridges are used for each filter.
      i) The 4 - size 17 and 19FA use two cartridges in the lube oil circuit
      ii) The 5 - size 17 and 19FA use four cartridges in the lube oil circuit.
2) The cartridge is made of 100% white wool or dacron pressed felt composed of 20 micron filter media and 5 micron partial filter media.

3) A micron is defined as the thousandth part of one-millimeter (.001 millimeter).
   a) The screen is 18 x 16 mesh aluminum with a wire diameter of .011”.
   b) The support tube is 3/16” expanded aluminum with both ends molded into epoxy and the cap.
   c) The felt washers are made of 100% white wool or dacron felt.
   d) The dual media used for cartridge allows the larger particles to be removed in the 20 micron mesh portion and the smaller particles in the 5 micron mesh portion. This design gives better efficiency of the filter.
   e) Observe oil and filter for contaminants and F.M.F note findings to system engineering for further analysis.
4) New filter cartridges packages come with gaskets, O-rings and felt washers. This allows the filters to be installed on various machines. Extra felt washers are provided to compensate for different length housings.
   a) We have not had to use the extra felt washers at this point. If the additional felt washer is required it should be installed at the bottom of the filter body, the alignment guide will hold it in place. You should experience the spring loading when installing the filter canister.
   b) Two O-rings are included in the package.
      i) The plain O-ring is used for high pressure refrigerants such as R-12, R-22, R-500, and R-134A.
      ii) The O-ring with the orange dot is used for low pressure applications using R-11 or R-123.
      iii) For this application, R-134A, use the O-ring without the orange dot.
      iv) Always use a lubricant on new O-ring we’ve been using Dow Corning 55 O-ring lubricant on all of our O-rings, new refrigerant oil is also acceptable.
5) When reinstalling filter housing be careful to not over tighten filter nut, snug fit is all that is required.

Recall the Lesson learned from enabling objective one, **good work practices**:

CRDR#110846 Oil leak on the essential chiller at the oil cooler inlet caused by excessive torque applied to the elbow during CM work.

Use this time to emphasize good work practices when torquing oil connections.

CRDR# 2934843 Essential chiller trip due to restricted oil flow caused by the woven felt gaskets at the top and bottom of each filter.

Use this time to emphasize good work practices when installing the filter canister.

Demo

Caution: De-energize the oil sump heater prior to removing the oil from the sump.

Demonstrate how the filters are disassembled and reassembled. Be sure to point out the correct items including the o-rings.

Refer to the Carrier training handout Chapter 2 for oil filters

Review the required documentation and disposal process for used chiller oil .

EO: 1.6 Discuss the process for changing the refrigerant filters.

Introduction

In this objective the trainee discuss replacing the refrigerant filter.

Main Idea

Assess and address workplace hazards.

Verify the refrigerant has been transferred and the shell pumped down completely prior to proceeding.

Refrigerant filter change out.

1) When changing out the refrigerant filters the refrigerant must be transferred and the shell pumped down completely.
2) The cartridges used with the refrigerant filter conform to carrier specifications.
   a) Four cartridges make up the filter dryer assembly.
3) To remove moisture and other contaminants from the refrigerant the cartridge is made of desiccant.
4) New filter cartridges are stored in canisters. These should remain in the canister until ready to install.
   a) Replace Gasket,
      i) Care must be taken when scraping gasket out of gasket groove, any scratches or grooves must be removed or leaks will accure.
      i) Always soak the new gasket in new chiller oil before installing.
5) When removing the filter housing, disassemble and clean all internal parts thoroughly.
6) Remove filter drier blocks from packages and assemble into the filter housing as soon as possible after opening. This will minimize the exposure time for the desiccant to absorb moisture and contaminants.
7) Replace the strainer screen in the filter drier core if required.
8) Place coupling in between cores (blocks).
9) Position felt pads between cores as directed by the vendor instructions.
10) Install assembly into shell with new flange gasket lubricated with new refrigerant oil.
11) Tighten bolts in a criss-cross pattern.

Lesson Learned:

OE19424 - Repair and Installation of Centrifugal Chiller CUNO Filters

Manufacturer: Carrier Model 17FA401-504-48

Part Number: CT-102

On 9/20/04, Operations personnel at Hope Creek identified a refrigerant leak after noticing the formation of ice on a skid mounted CUNO filter. Immediate actions performed included securing the chiller, evacuating the area for personal safety issues due to the presence of R-114 refrigerant, and pumping down the chiller refrigerant charge to the storage vessel.

Because of the leak, the 1BK403 chiller was declared inoperable. Station personnel subsequently determined that improper installation and assembly of the CUNO filter caused the leak.

Initially, maintenance personnel considered that the refrigerant leak was coming from the filter o-ring gasket; however a follow-up maintenance inspection found the filter housing to be slightly tilted from vertical, and missing the band clamp used to ensure that the filter is securely fastened in its cradle. A review of work history indicated that the filter cartridges had recently been replaced in August 2004 during a planned maintenance activity.

To repair the leak, maintenance personnel removed the filter sump, re-welded the filter cradle to the chiller skid, and installed a new filter head o-ring gasket and sump. Post-maintenance pressure testing of the chiller verified that the leak was repaired, and 1,150 lbs of R-114 refrigerant was added to the chiller prior to releasing it to station operators for operability testing. Satisfactory testing of the chiller was completed and the LCO exited at approximately 0447
hours on 9/25/04.

During the repair process, station personnel performed walk-downs on all Hope Creek centrifugal chillers and confirmed that their installed piping and filter configuration were satisfactory. A review of maintenance procedures was also performed at that time, and the filter manufacturer was also consulted.

As a result of these reviews, it was determined: 1) That the leak occurred due to improper installation of the CUNO filter, 2) That the existing maintenance procedure contained insufficient guidance for proper removal/installation of the filter sump and for the replacement of CUNO filter elements, and 3) That the missing band clamp probably did not contribute to the formation of the leak, although it does provide additional support to the filter and copper refrigerant line.

OE 11587 - Failure of Control Room Ventilation System Chillers

1) What happened?

On 9/20/04, Operations personnel at Hope Creek identified a refrigerant leak after noticing the formation of ice on a skid mounted CUNO filter. Immediate actions performed included securing the chiller, evacuating the area for personal safety issues due to the presence of R-114 refrigerant, and pumping down the chiller refrigerant charge to the storage vessel.

2) Why did it happen?

1) The leak occurred due to improper installation of the CUNO filter, 2) That the existing maintenance procedure contained insufficient guidance for proper removal/installation of the filter sump and for the replacement of CUNO filter elements, and 3) That the missing band clamp probably did not contribute to the formation of the leak, although it does provide additional support to the filter and copper refrigerant line.

3) Could this type event happen at PV? Are there any known equipment problems the can group identify that may be applicable?

4) What could you do to prevent this from happening?

Demo

Demonstrate how the filters are disassembled and reassembled.

Be sure to point out the correct items including the o-rings.

EO: 1.7 Discuss the process of inspecting and replacing the refrigerant PSV's

Introduction

In this objective the trainee will learn what to look for when inspecting the refrigerant pressure safety relief valve and how to replace them.

Main Idea

Assess and address workplace hazards.

Verify the refrigerant has been transferred and the shell pumped down completely prior to proceeding.

Use a back-up wrench for removal.

The inspection may be performed prior to pumping down the chiller.

1) All pressure vessels are required to have some type of pressure relief.
2) ASME specifications are stamped on the machine.
3) The pressure safety valves for the chillers should be inspected for signs of corrosion.

Note: The PSVs on the Essential chillers are replaced every 5 years. So no inspection is required. The Normal chillers are inspected every year and replaced every 5 years.

   a) Disconnect vent piping at valve outlet. (Union half and piping)
   b) Inspect valve body and mechanism for any evidence of internal corrosion or foreign material (rust,dirt,scale,etc.). **Whats the worst thing that could happen?** Excessive rusting of the PSV could cause a catastrophic leak of refrigerant which could then cause the tubs to rupture.
   c) Verify PSVs and piping are free of foreign material.
   d) The normal chillers have pipe elbow installed on the outlet to prevent rain from entering the valve and rusting out the disc.
   e) Reinstall vent piping.

4) When replacing the valves ensure that the pressure rating of the valve being installed matches the vessel.
   a) Pressure rating of the cooler PSV's.
      i) 2 on the Essential chiller at 185 psig
      ii) 3 on the Normal chiller A,B,C at 185 psig
      iii) 2 on the Normal chiller E02 at 185 psig
   b) Pressure rating of the storage tank.
      i) 2 on the Essential chiller at 285 psig
      ii) 2 on the Normal chiller A,B,C at 285 psig

iii) 2 on the Normal chiller E02 at 285 psig

c) Pressure rating of the pumpout condenser.

i) 1 on the Essential chiller at 385 psig

ii) 1 on the Normal chiller A,B,C at 385 psig

iii) 1 on the Normal chiller E02 at 385 psig

SUMMARY OF MAIN PRINCIPLES

The following items are things to consider in your lesson summary. They are not mandatory. You should develop your own summary.,

Objectives Review

Review the Lesson Objectives

Topic Review

Restate the main principles or ideas covered in the lesson. Relate key points to the objectives. Use a question and answer session with the objectives.

Questions and Answers

Oral questioning

Ask questions that implement the objectives. Discuss student's answers as needed to ensure the objectives are being met.

Problem Areas

Review any problem areas discovered during the oral questioning, quiz, or previous tests, if applicable. Use this opportunity to solicit final questions from the students (last chance).

Concluding Statement

If not done in the previous step, review the motivational points that apply this lesson to students needs. If applicable, end with a statement leading to the next lesson.

You may also use this opportunity to address an impending exam or practical exercise.

Should be used as a transitional function to tie the relationship of this lesson to the next lesson. Should provide a note of finality.