Engineering Report No. IP3-RPT-UNSPEC-03499 Rev 1
Page 1 of 15

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Engineering Report Cover Sheet

Engineering Report Title:
INDIAN POINT UNITS 2 & 3
EDDY CURRENT PROGRAM

Engineering Report Type: (3)

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P3-RPT-UNSPEC-03499
REVISION HISTORY

Revision	Reason
1	To incorporate latest information; to modify IP3 EC sizing error to 10% to be consistent with IP2; and to include IP2 data. To address NRC observation regarding CCW HX tube sampling and trending (Ref. 3.14)

TABLE OF CONTENTS

Section **Page**

1.0 **SCOPE AND OBJECTIVE** 4

2.0 **DISCUSSION** 4

2.1 Program Ownership 4
2.2 Program Licensing Basis / Regulatory Requirements / Commitments 4
2.3 Component Selection Criteria 5
2.4 Inspection Frequencies 6
2.5 Sampling Plan / Scheme 6
2.5.1 Extent of Condition 7
2.6 Tube Plugging Criteria 8
2.7 Heat Exchanger Replacement Criteria 9
2.8 Plant Condition for Inspections 10
2.9 Vendor Services Contract 10
2.10 Program Budget 11
2.11 Eddy Current Reference (Calibration) Standards 11
2.12 Conduct of Eddy Current Examinations 11
2.13 Eddy Current Reports and Records Management 12
2.14 Root Cause Analysis 13
2.15 Operating Experience (OE) 13
2.16 Baseline Examinations 14
2.17 Vendor Site Specific Training and Access Control 14

3.0 **REFERENCES** 14

4.0 **APPENDICES** 15

Appendix 1: IP2 BOP Heat Exchangers in Eddy Current Program (4 pages)
Appendix 2: IP3 BOP Heat Exchangers in Eddy Current Program (4 pages)
Appendix 3: IP2 Eddy Current Program – Tube Plugging Criteria (2 pages)
Appendix 4: IP3 Eddy Current Program – Tube Plugging Criteria (2 pages)
Appendix 5: IP3 Calibration Tube Index (4 pages)

1.0 SCOPE AND OBJECTIVE:

This document describes the Indian Point Units 2 & 3 (IPEC) Eddy Current Program.

The objective of the Eddy Current Program is to:

- Assess current conditions of selected heat exchangers using reliable and proven eddy current inspection techniques.
- Minimize tube leaks by targeting key heat exchangers for inspection.
- Devise a tube-sampling scheme to ensure that an inspected heat exchanger will remain trouble-free for the duration of an operating cycle.
- Specify tube plugging criteria.
- Plan for timely heat exchanger tube bundle replacements by estimating remaining heat exchanger operating life.

This document ensures a consistent approach to inspecting, testing, and maintaining heat exchangers that can be implemented by the cognizant engineering individual(s).

Eddy current inspection of the Steam Generators is outside the scope of this program. See Reference 3.3 for a detailed description of the Steam Generator Program.

2.0 DISCUSSION:

The following sections provide a general discussion of each major aspect of the program.

2.1 Program Ownership

The IPEC Eddy Current Program is owned and administered by Programs and Component Engineering. Administration of the program is assigned to a responsible Component Engineer. Successful program implementation requires a close working relationship with personnel in the Maintenance, Systems Engineering, and Work Control departments.

2.2 Program Licensing Basis / Regulatory Requirements / Commitments

The IPEC Eddy Current Program is a stand-alone program, administered under the Preventive Maintenance (PM) program.

The IPEC Eddy Current Program is not part of the ASME Section XI ISI/IST programs (Ref. 3.1). The ASME Code does not mandate BOP heat exchanger eddy current inspections. As such, inspections are not performed for specific compliance with any ASME B&PV Code Section V or XI commitments or requirements. ASME B&PV Code Section V, Article 8, Appendix I is utilized for the development of OD flaw calibration standards.

Furthermore, ASME Section XI does not provide code allowable minimum wall requirements for heat exchanger tubing. Tube plugging guidance was developed using EPRI recommendations and other engineering inputs as discussed in Section 2.6.

Eddy current inspections of Service Water (SW) cooled heat exchangers are not performed for compliance with any specific G.L. 89-13 commitments (Ref. 3.2). However, performance of SW heat exchanger eddy current inspections may be used as further evidence of a successful "inspect and clean" program as committed to for 89-13 compliance.

There are no FSAR or Technical Specification, NRC commitments, or NRC Regulatory Guide requirements applicable to this program

2.3 Component Selection Criteria

All plant heat exchangers required for efficient and reliable power generation, except for the Steam Generators, are included in the IPEC Eddy Current Program. The Steam Generators are included in their own inspection program (see Ref. 3.3). Eddy current inspection of the reactor pressure vessel (RPV) in-core thimble tubing is generally performed by Westinghouse. While not considered heat exchanger tubing, it is included within the program for tracking purposes.

Heat exchangers with higher relative risks for failure potential and consequences (plant shutdown and/or radiation release) are included. As a necessity due to the aggressive nature of Hudson River water in contributing to tubing material corrosion, all Service Water System cooled heat exchangers are included in the program.

Screening criteria used for inclusion of a heat exchanger into the program is as follows:

- Plant System –all heat exchangers that can affect plant safety and power generation, and all systems supporting plant safety are considered. Components exhibiting high failure potential and/or significant consequences of failure as determined by PRA/IPE analyses are also included.

  Parameters associated with failure potential include (Ref. 3.4):

  1. Total hours of operation
  2. Hours since last EC inspection
  3. Effectiveness of NDE methods employed
  4. Intuitive operator assessment
  5. Chemistry/excursion effects
  6. Operating capacity factor of the heat exchanger
  7. Throttling of valves
  8. Metallurgy
  9. Water chemistry
  10. Lay-up procedures / history
  11. Previous failure history

  Parameters associated with consequences of failure include (Ref. 3.4):

  1. Percentage of plugged tubes
  2. Ease of heat exchanger isolation
  3. Availability of redundant coolers
  4. Percent loss of unit load
  5. Safety function impact
  6. Environmental impact
  7. Impact on unit availability (economic impact of repair/replacement)

- Size – small heat exchangers that are more economical to replace rather than inspect are excluded from the program.
- Maintenance History – heat exchangers with a previous plugging history are included.
- Inspection History – heat exchangers that have been previously eddy current tested are included.

- Turbine-Generator –all heat exchangers supporting the turbine-generator are included.
- Raw Water –all Service Water-cooled heat exchangers are included.
- New Components –all new heat exchanger installations are considered for program inclusion.

In addition to the above initial selection criteria, heat exchanger performance is evaluated on an on-going basis. Any components exhibiting any of the following typical signs of operational problems would be potential causes for inclusion into the program on a temporary or permanent basis:

1. Leaking tubes.
2. Significant change in chemistry on the tube or shell side.
3. Presence of radioactivity or increased radiation levels on the tube or shell side.
4. Loss of component or plant efficiency due to poor thermal performance.
5. Difficulty in controlling water level due to changes in pressure or flow.
6. Unusual noises that may be due to flow-induced tube fretting or a loose part.
7. Changes in cathodic current with little change in water conductivity.

Heat exchangers selected for inclusion into the Eddy Current Program are listed in Appendices 1 (IP2) and 2 (IP3). The components selected are consistent with current nuclear industry practices. Components may be added to, or deleted from, the program on an on-going basis as deemed necessary, including as the result of industry operating experience (OE) feedback.

2.4 Inspection Frequencies

Eddy current inspection frequencies are stated in Appendices 1 and 2 for each component. The current frequencies are based on plant-specific and application specific knowledge, as well as past history, current heat exchanger operating conditions, and unit availability/outage schedules. The established intervals are selected in order to uncover potential tubing problems before failure occurs. Continual optimization of the frequencies is an on-going process using the results of the latest inspections and the component's historical results. Inspection results are recorded and archived as part of an on-going inspection database which permits optimization of inspection frequencies.

Components whose inspection results continually indicate no new indications or growth of prior indications found in previous inspections are candidates for inspection frequency lengthening. Conversely, the inspection frequencies for components with indications in excess of the plugging criteria and/or increases in the growth rates of previously identified flaws will be evaluated as to whether or not the current frequencies should remain as-is or be shortened.

All eddy current inspection frequencies, as applicable, are adjusted via an Engineering Change Request (ER) in MAXIMO.

2.5 Sampling Plan / Scheme

In general, 100% of the tubes will be inspected for small heat exchangers. A sample plan of less than 100% of the total number of tubes is acceptable for heat exchangers with titanium, AL-6X, AL-6XN, or 300 series stainless steel material tubing, depending on the component's specific operating history. This is based on good overall historical inspection results with these materials, and in order to save time, manpower, and expenditure of unnecessary funds, especially during refueling outage periods.

For heat exchangers with less than a 100% sample (e.g., main condensers, feedwater heaters, MSRs, etc), a combination of random and systematic (i.e., targeted) sampling is used. This sampling scheme is based on knowledge of expected and known damage mechanisms for the particular component from past examination results or repair records, as well as a random selection of tubes to detect new potential problems. The following are considerations in determining the proper tube sampling scheme:

- Component operating history.
- Mechanical design.
- Visual examination results.
- Economics and scheduling.
- Feasibility in accessing tube ends.

For heat exchangers with copper alloy (brass and bronze) tubing, a 100% tube inspection is desirable. However, for heat exchangers in this category, such as CCW HX, having several thousand tubes, a 100% inspection may not be practical during each on-line inspection. In those cases, an inspection plan should be developed as follows:

> The targeted group, in these cases, should include all moderately degraded tubes (40% wall loss and greater, or as determined by component engineering) from previous inspection; tubes around all plugged tubes; and leaking tubes (if any) and tubes around them. All tubes in this targeted group should be inspected first.
>
> Using the remainder of the allowed outage time, previously not inspected tubes should be pursued. The intent is to achieve complete inspection of all tubes in a few PM cycles.

EPRI has stated that in order to have a 70% or better probability of detecting degraded tubes, a sampling scheme of 40% is nearly as effective as a 100% inspection (Refs. 3.4 and 3.5). Inspection scopes of less than 40% of the total number of tubes, as is the case for a number of the heat exchangers included in the program, can also approach the 70% confidence level through use of optimized random and systematic sampling schemes.

In general, in cases where less than a 100% inspection is performed, all surrounding tubes are inspected for each tube found to exceed the plugging criteria, if these surrounding tubes were not part of the original sample size. This provides assurance that any damage mechanism that can affect more than one tube will be identified. In addition, all tubes surrounding each previously plugged tube are inspected as part of the initial sampling plan for the same reason.

Appendices 1 and 2 provide approximate sampling size (in percentages of the total number of tubes) for each heat exchanger included in the program. When less than a 100% inspection is performed, an effort is made to ensure that the tubes randomly selected during each inspection are different from the tubes randomly selected in previous inspections in order to achieve closer to a 100% inspection over the course of many inspections. Sampling sizes are approximate only, and the actual number inspected may be more or less than the stated percentage.

2.5.1 Extent of Condition

For heat exchangers with less than a 100% inspection scope, expansion of the original sample size will be performed when unexpected conditions are encountered. Sample size expansion will be increased as deemed appropriate in the following situations:

- A marked increase in the number of tubes showing damage from the previous inspection.
- A marked increase in the severity of previously identified damage, considering the length of service time since the last inspection.
- Damage indications different from the expected damage conditions, e.g., OD wear or cracking, if ID pitting was the only damage mechanism previously identified.
- Operating experience, and vendor recommendation.

Due to the individual characteristics of each heat exchanger (service conditions, time since last inspection, etc.), the actual increase in sample size that is determined will depend on many factors, and can only be determined at the time of inspection. If the inspection results indicate a problem in only a certain area of the heat exchanger, the scope will only be expanded to cover the affected area, in a bounding approach.

A Condition Report (CR) will be initiated, when deemed necessary. CRs will be initiated if there are safety or operability implications, in order to notify plant management, to evaluate extent of condition, and for trending purposes. The extent of condition evaluation will include inspection requirements for similar plant heat exchangers, e.g., the #31, #33 and #34 hydrogen coolers, if #32 is found to be degraded.

2.6 Tube Plugging Criteria

When evaluating the eddy current inspection results, it is necessary to know the maximum acceptable tube wall loss in order to determine whether tube plugging is required. ASME Section XI does not provide code allowable min. wall requirements for heat exchanger tubing.

The Electric Power Research Institute (EPRI) provides general guidance for determining heat exchanger tube-plugging criteria in Refs. 3.4 and 3.5. The Ref. 3.6 report utilizes this guidance and provides tube-plugging criteria recommendations for various IP2 balance-of-plant heat exchangers.

The Ref. 3.7 report utilizes this guidance and provides tube-plugging criteria recommendations for various IP3 balance-of-plant heat exchangers. Heat exchangers with previously existing information or calculations are not included in the Ref. 3.7 report, and this report is not meant to supersede any of these documents.

Appendices 3 (IP2) and 4 (IP3) provide a summary of the plugging criteria, taken from References 3.6 and 3.7 and other applicable engineering inputs, for these and all other components in the program.

Tube plugging criteria is stated as "percent wall loss from nominal" and was determined from consideration of the following factors as applicable to each heat exchanger, as well as NDE accuracy in terms of sizing error:

1. Consequence of leakage
2. Safety-related function
3. Damage mechanisms
4. Flaw growth rate
5. Tube material type
6. Leak detection provisions

7. Water chemistry
8. Fouling potential
9. Design pressure
10. Design temperature
11. Design flows

A heat exchanger tube-plugging summary giving the exact count of plugged tubes for each component is maintained on an on-going basis, as shown in Appendices 1 and 2. It is periodically updated for each heat exchanger in the program, typically after each inspection. Contact Component Engineer for latest update.

Tube sheet maps showing the number and locations of all plugged tubes for each heat exchanger in the program are contained in the final eddy current reports, which are submitted to MERLIN.

2.7 Heat Exchanger Replacement Criteria

Unless a specific calculation has been previously prepared to the contrary, a heat exchanger and/or tube bundle will be identified for replacement if tube plugging has reached 10% or more of the total number of tubes. If excess heat exchanger tube margin exists, the defective tubes exceeding the established criteria will be plugged until the threshold criteria is met. If the tubing problems are found to be localized only and do not affect overall design function, an option that will be considered is to replace only those specific affected tubes in order to gain lost margin, rather than to replace an entire tube bundle or heat exchanger.

Part of the evaluation of inspection results is the estimation of heat exchanger remaining service life. Tubes that exceed the established plugging criteria will be identified for plugging as previously mentioned. The inspection results will be compared with previous successive data in order to estimate a growth rate of tube damage. If the growth rate for a particular tube is estimated to result in the tube exceeding the established plugging criteria prior to the next scheduled inspection, the tube will be plugged as a precautionary measure. If the growth rate is small, the degraded tubes will not be plugged and will remain in service. When it is estimated that the entire tube bundle will reach maximum plugging, plans will be initiated for tube bundle replacement (or complete heat exchanger replacement depending on the component's overall condition). Tubing will be replaced with the same material alloy. Design modifications can be requested to install improved material alloys depending on the specific circumstances. By knowing the number of already plugged tubes, the total number of allowable tubes that can be plugged without compromising the intended heat exchanger design functions, and the expected number of tubes to be plugged over an operating period, makes it possible to estimate the remaining heat exchanger service life.

Appendices 1 and 2 also provide the maximum number of tubes that can be plugged for each heat exchanger included in the program.

The following formula may be used as a trending tool to assess the remaining life of a tube bundle which is approaching its plugging limit. This is only for guidance and the bundle replacement will depend on previous operating history, overall material condition, etc.

$T = (B-L-P)/R$

T - Remaining life of tube bundle in number of refueling cycles
B - Total tubes in bundle

L - Minimum number of tubes required to maintain adequate heat transfer
P - Number of tubes plugged previously
R - Number of tubes plugged in current inspection cycle (Note: formula not valid if R=0)

(This is based on Ref. 3.4, EPRI report: Balance-of-Plant Heat Exchanger Condition Assessment and Inspection Guide, Dec. 1999, TR-108009, Appendix A, Section 20.2.1)

2.8 Plant Condition for Inspections

Eddy current inspections will be performed on-line when feasible, to the maximum extent practical. In cases where a component is not redundant or when a short Allowed Outage Time (AOT) applies, such that a component cannot be inspected without a plant power reduction or outage, such a component will be inspected during refueling outages, or will be inspected on-line with a reduced inspection scope, if justifiable. The specific components selected for inspection during a refueling outage, as well as the sampling scheme, will be determined well in advance of the outage.

A detailed outage schedule will be developed listing each component during the refueling outage. Following each refueling outage, CRs and or ERs, as applicable will be generated and Appendices 1 and 2 will be updated. Additionally, a component health report for all GL 89-13 related heat exchangers will be provided on a quarterly basis. Furthermore, an annunciator window report for all BOP heat exchangers will be provided on every quarter.

IPEC Work Control will schedule on-line inspections during the plant's 12 week rolling schedule. Inspections will be specified for the particular work week that is associated with the plant system of the heat exchanger.

Appendices 1 and 2 contain the current plant condition that each component will be inspected (i.e., either on-line or outage).

2.9 Vendor Services Contract

An Entergy approved vendor will perform all eddy current inspection services for IPEC. The selected vendor shall have a 10CFR50 Appendix B QA program since some components are safety related. All work shall be performed in accordance with a formal services contract.

Vendor personnel performing inspections shall be qualified and certified in accordance with American Society for Nondestructive Testing (ASNT) Recommended Practice SNT-TC-1A (Ref. 3.8).

Entergy's normal contract services procurement process applies for the solicitation and evaluation of bids. The services contract details the final negotiated rates for the vendor's services as well as all other relevant details. WPO Programs group is responsible for selecting the vendor and preparing a General Services Agreement (GSA) contract. Yearly funding to the contract is the responsibility of the Programs and Component Engineering Department.

2.10 Program Budget

A yearly program budget is established based on the anticipated number of inspections during the calendar year. The responsible Component Engineer is tasked with developing a budget estimate for the upcoming year and ensuring the program is implemented and remains within the approved budget. Additional funding shall be requested when justified.

Vendor invoices will be forwarded to the responsible Component Engineer. They will be expeditiously reviewed, approved, and forwarded to Accounting for payment. A running tally of program expenses versus budget will be maintained.

2.11 Eddy Current Reference (Calibration) Standards

Eddy current is an inference-based examination method. In order to perform meaningful examinations, appropriate reference standards must be used to infer the unknown tubing conditions. Reference standards (calibration tubes) are maintained at the site for each IP3 component in the program, with the exception of the RPV in-core thimble tubes. The IP3 thimble tube inspection has been performed by Westinghouse who maintains their own calibration tubes.

The eddy current vendor maintains calibration standards for all IP2 BOP heat exchangers in the program, including the RPV in-core thimble tubes.

Some calibration standards have been in accordance with ASME B&PV Code Section V, Article 8, Appendix I. These "ASME" standards are used for those heat exchangers with tubing potentially subject to developing OD flaws such as denting, erosion, fretting, etc. ID pit standard calibration tubes have been fabricated for use in SW heat exchanger inspections where the predominant degradation mode is ID corrosion and pitting.

The type of calibration standard chosen for each heat exchanger emulates, as closely as possible, the most likely flaw types that will be encountered.

Each calibration tube has an associated detailed drawing showing dimensions and the machined-in defects. Calibration tubes used for QA Category I or Category M applications will be procured with the appropriate QA controls.

An index of all calibration tubes is maintained by Programs and Component Engineering (P&CE) as shown in Appendix 5. Material certification records and drawings are also maintained by P&CE.

In cases where new heat exchangers are added to the plant for the first time via modifications, or where a tube bundle's material has been changed to a different material alloy, additional tubing material will be procured and sent to EPRI or another off-site vendor for the necessary calibration tubes.

2.12 Conduct of Eddy Current Examinations

Eddy current examinations for all IPEC BOP heat exchangers will be performed in accordance with approved MAXIMO work requests, per Maintenance Procedure 0-HTX-400-GEN, latest revision (Ref. 3.9), and previously approved vendor procedures.

Frequencies of inspection and scheduling of work requests are maintained and controlled under the plant PM Program.

Cleaning of heat exchanger tubes will normally be performed prior to an eddy current inspection in order to remove any internal conductive deposits which may skew results, and to clear any blocked tubes which may damage probes and/or prevent inspection of the entire tube lengths. Preferred tube-cleaning methods are water washing with non-metallic brushes or scrapers and high-pressure hydrolazing. Heat exchanger cleaning PMs are performed as separate work requests and are outside the scope of the eddy current vendor's services. The "as-found" condition of the tubesheets and tube ends after cleaning will be recorded by the EC vendor prior to data acquisition and will be reported in the vendor's preliminary and final reports.

The eddy current vendor, based on experience and tubing material type and wall thickness, will select the optimum technique(s) for examination. In general, four (4) frequencies will be selected and used. The vendor will be responsible for the following specifics:

- Selection of frequencies.
- Selection and use of the proper probes (type, size, etc.).
- Determination of the proper probe pull speed.
- Use of differential and/or absolute signals, and phase angle and/or amplitude analysis for data interpretation.

In order to have data that is the most comparable from inspection to inspection, the same operating frequencies, probe types and sizes, and eddy current instruments will be used to the maximum extent practical.

2.13 Eddy Current Reports and Records Management

Immediately following completion of each eddy current inspection, the eddy current vendor will provide a preliminary hardcopy report to the responsible Component Engineer or his designee for approval/acceptance. The preliminary reports will have the following information, at a minimum:

- Total number of tubes inspected.
- Breakdown of tubes recording damage by percentage wall loss range.
- Damage mechanism(s) found.
- A count of previously plugged tubes and blocked tubes.
- Number and location of tubes recommended for plugging.
- Visual tubesheet and tube end inspection results.

The responsible engineer, following concurrence with the vendor recommendations for tube plugging, will approve the preliminary report and authorize the vendor to mark the tubes and/or tubesheet in order to facilitate plugging of the tubes. The actual installation of tube plugs is outside the scope of the eddy current vendor's services; presently it is performed by Maintenance.

Copies of the preliminary reports will be provided to Maintenance and Systems Engineering. A copy of the preliminary report will be included in the work package. A copy will be maintained in engineering website for easy retrieval. The Component Engineer will maintain the latest tube sheet maps for reference.

Three (3) copies of a final eddy current inspection report (hardcopy) will be provided by the vendor to the responsible engineer, generally within 60 days. The report will expand on the preliminary report and include additional items such as:

- Vendor and site personnel involved in the inspection;
- Equipment used;
- Inspection procedures / techniques;
- Data sheets with results for each individual tube;
- Tubesheet maps showing locations of indications;
- Detailed discussion of findings and results.
- Certification records for the personnel and equipment used.

The final report will be reviewed and approved in accordance with ENN-DC-149 (Ref. 3.10) in a timely manner by the responsible Component Engineer. The reports will then be distributed as follows:

- MERLIN
- Systems Engineering
- Maintenance

Electronic media (CDs and magnetic tapes) of the inspection results are the property of Entergy. They are, however, maintained by the vendor in the vendor's offices. They are available for retrieval and review upon request.

Vendor personnel certification records and equipment calibration records are maintained by the eddy current vendor and are also available for review upon request. QA Department personnel are required to verify these records for all inspections of QA Category I and Category M components. Such records, following verification, are included in the associated work packages and in the final vendor eddy current reports.

A record of all inspections for each component in the program is maintained on an on-going basis, as shown in Appendices 1 and 2.

2.14 Root Cause Analysis

In cases of tube leaks or damage mechanisms due to unknown causes, it may be decided to pull a tube or tubes in order to perform metallurgical failure analysis. Metallurgical analysis of failed tubes will be coordinated with WPO Engineering Programs, and most likely conducted by contracted outside metallurgical laboratories.

Tube stabilization using tie-rods or wire for pulled tube sections and for those tubes experiencing flow-induced vibration damage or cracking may be required, based upon the inspection results. Use of tube sleeves is another potential option to extending a tube's life. Pulling of tubes, and tube staking and sleeving, will be performed by Maintenance Department personnel and/or outside contractors. This work is also outside the scope of the eddy current vendor's services.

Similarly, it may be decided to perform leak testing to determine if a heat exchanger is leaking, or to locate leaking tubes. This work is outside the scope of the eddy current vendor's services and will be performed by Maintenance Department personnel and/or outside contractors.

2.15 Operating Experience (OE)

The IPEC Operations Review Group (ORG) screens nuclear industry events and will notify P&CE of any significant events applicable to IPEC and eddy current testing. Based on the OE feedback received, changes will be made, as deemed necessary, to the

program component selection criteria, inspection scopes or techniques, frequencies of inspection, etc.

In addition, the program's cognizant engineering individuals attend eddy current testing related industry seminars and training on an on-going basis. Any information obtained from these sources will be incorporated into the program as determined necessary.

2.16 **Baseline Examinations**

Whenever a complete heat exchanger and/or tube bundle is replaced, a baseline eddy current inspection will be performed whenever possible in order to ensure suitability of the component for service and to allow for proper future trending of condition. Scheduling and performance of baseline examinations is the responsibility of the Component Engineer and will be conducted by approved MAXIMO work requests.

Baseline examinations of components to be replaced during plant refueling outages will be performed prior to the outage whenever feasible in order to reduce outage work scope. However, it is recognized that in doing so, damage caused by movement or installation of the bundle may render the inspection results inaccurate. In such cases, the site installers must notify the P&CE to perform another baseline inspection to ensure no unacceptable damage has resulted.

2.17 **Vendor Site Specific Training and Access Control**

The Component Engineer is responsible for sponsoring eddy current vendor personnel for unescorted access to the OCA, protected and vital areas of IPEC. Sponsoring of vendor personnel for unescorted access will be in accordance with applicable plant access control procedures. This includes submittal of appropriate access forms to Access Control, as well as notifying Access Control when unescorted access is no longer required. For plant refueling outages when the majority of the program inspections are performed, the vendor will provide a listing of outage personnel to the responsible engineer well in advance of the outage in order to permit proper and efficient handling of the required paperwork.

Vendor personnel will be "processed" by the responsible Component Engineer or his designee to meet the following requirements.

- Verification of work qualifications for each individual contractor employee.
- Scheduling and verification of GET / badging training.
- Whole body counts and TLDs have been obtained if necessary.
- Notifications are made to Access Control to request or terminate unescorted access.
- Ensuring exit interviews are conducted, as appropriate.

The responsible engineer will also approve Property Removal Passes on an as-needed basis for vendor-owned equipment brought into and out of the protected area.

3.0 **REFERENCES**:

3.1 ENN-DC-332, "Inservice Testing"

3.2 NRC Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment"

3.3 IP-RPT-04-00206, "Indian Point 2 Steam Generator Program", and IP3-RPT-SG-01796, "Indian Point 3 Steam Generator Program"

3.4 EPRI TR-108009, "Balance-of-Plant Heat Exchanger Condition Assessment and Inspection Guide," Final Report, December 1999

3.5 EPRI TR-110392, "Eddy Current Testing of Service Water Heat Exchangers for Engineers Guideline," Final Report, February 1999

3.6 IP2-EC-GUIDELINE NO. 1, "IP2 Eddy Current Program: Tube Plugging Criteria for BOP Heat Exchangers"

3.7 IP3-RPT-UNSPEC-03498, "IP3 Eddy Current Program: Balance-Of-Plant Heat Exchanger Tube Plugging Criteria"

3.8 American Society for Nondestructive Testing (ASNT) Recommended Practice No. SNT-TC-1A, "Personnel Qualification and Certification in Nondestructive Testing"

3.9 Maintenance Procedure 0-HTX-400-GEN, "Eddy Current Inspection of Heat Exchanger Tubes"

3.10 ENN-DC-149, "Control, Review, Comment & Acceptance of Vendor Documents"

3.11 Memo to File, PEP-DPP-2004-043, Service water Heat Exchanger Tube Plugging Criteria, dated October 6, 2004.

3.12 Balance-of-Plant (BOP) Eddy Current Inspection Services for the Entergy Northeast Fleet, WPO-SPEC-001.

3.13 SWAP Survey 01-14, Update of Eddy Current Testing of Heat Exchangers, Sept. 14, 2001.

3.14 CR-IP2-2006-03974, CA-2.

4.0 APPENDICES:

Appendix 1: IP2 BOP Heat Exchangers in Eddy Current Program
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Appendix 5: IP3 Calibration Tube Index

IP2 BOP Heat Exchangers in Eddy Current Program

(For information only)

	MAXIMO Location	Heat Exchanger Description	Safety Related ? (Yes or No)	When PM Inspected (On-line or Outage)	When EC Inspected (On-line or Outage)	Percent of Tubes EC Inspected	Total No. of Tubes	Tube Type (Straight or U-tube)	Straight Length of Tube	Tube O.D., in	Tube BWG	Tube Material	Tube Plugging Limit	No. of Plugged Tubes	Eddy Current History	Comments
1	21CCHX	Component Cooling Water	Yes	On-line 24Mo	On-line 24Mo	75%	1750	Straight	20 ft	0.75	.049 in	90/10 Cu Ni SB-111-706	5%, per WCAP-12312 (Westinghouse safety eval for 95 deg.); i.e., 88 tubes	10	2/22/2005	6 tubes (3 w/ wall loss, 3 blocked) were plugged on 2-22-05
2	22CCHX	Component Cooling Water	Yes	On-line 24Mo	On-line 24Mo	75%	1750	Straight	20 ft	0.75	.049 in	90/10 Cu Ni SB-111-706	5%, per WCAP-12312 (Westinghouse safety eval for 95 deg.); i.e., 88 tubes	32	2/14/2005	12 tubes were plugged on 2-15-05
3	21CRFCC	21 Cont Recirc Fan Cooling Coils	Yes	On-line 72 Mo	On-line 144 Mo	20%	1392(696 U	Straight	9 ft	0.625	.028 in.	AL6X, w/fins	5%	0	2R15	
4	22CRFCC	22 Cont Recirc Fan Cooling Coils	Yes	On-line 72 Mo	On-line 144 Mo	20%	1392	Straight	9 ft	0.625	.028 in.	AL6X	5%	0		
5	23CRFCC	23 Cont Recirc Fan Cooling Coils	Yes	On-line 72 Mo	On-line 144 Mo	20%	1392	Straight	9 ft	0.625	.028 in.	AL6X	5%	0	2R15	
6	24CRFCC	24 Cont Recirc Fan Cooling Coils	Yes	On-line 72 Mo	On-line 144 Mo	20%	1392	Straight	9 ft	0.625	.028 in.	AL6X	5%	0		
7	25CRFCC	25 Cont Recirc Fan Cooling Coils	Yes	On-line 72 Mo	On-line 144 Mo	20%	1392	Straight	9 ft	0.625	.028 in.	AL6X	5%	0		
8	21CRFMC	21 Cont Recirc Fan Motor Cooling Coils	Yes	On-line 120 Mo	On-line 240 Mo	33%	64	U	3 ft	0.625	.028 in.	AL6X, w/fins	5%	0	2R15?	Freq changed 4-26-05; IP2-05-15612
9	22CRFMC	22 Cont Recirc Fan Motor Cooling Coils	Yes	On-line 120 Mo	On-line 240 Mo	33%	64	U	3 ft	0.625	.028 in.	AL6X	5%	0		
10	23CRFMC	23 Cont Recirc Fan Motor Cooling Coils	Yes	On-line 120 Mo	On-line 240 Mo	33%	64	U	3 ft	0.625	.028 in.	AL6X	5%	0	2R15?	
11	24CRFMC	24 Cont Recirc Fan Motor Cooling Coils	Yes	On-line 120 Mo	On-line 240 Mo	33%	64	U	3 ft	0.625	.028 in.	AL6X	5%	0		
12	25CRFMC	25 Cont Recirc Fan Motor Cooling Coils	Yes	On-line 120 Mo	On-line 240 Mo	33%	64	U	3 ft	0.625	.028 in.	AL6X	5%	0		
13	21CWHX	IA Closed Cooling HX	Yes	On-line 24 Mo	On-line 24 Mo	100%	62	Straight	7 ft	0.625	.065 in	Admiralty	5%	0	7-5-06; 6/8/2004	
14	22CWHX	IA Closed Cooling HX	Yes	On-line 24 Mo	On-line 24 Mo	100%	62	Straight	7 ft	0.625	.065 in	Admiralty	5%	0	2/14/2005	
15	21EDJC	EDG Jacket Water Cooler	Yes	On-line 6 Mo	On-line 72 Mo	15%	886	Straight	6.25 ft	.375 in	.028 in	Titanium SB-338	7.67%	0	2/25/2003	
16	22EDJC	EDG Jacket Water Cooler	Yes	On-line 6 Mo	On-line 72 Mo	15%	886	Straight	6.25 ft	.375 in	.028 in	Titanium SB-338	7.67%	0	2R15	
17	23EDJC	EDG Jacket Water Cooler	Yes	On-line 6 Mo	On-line 72 Mo	15%	886	Straight	6.25 ft	.375 in	.028 in	Titanium SB-338	7.67%	0	2R15	
18	21EDLC	EDG Lube Oil Cooler	Yes	On-line 6 Mo	On-line 72 Mo	20%	326	Straight	5.85 ft	0.5 in	.028 in	Titanium SB-338	9.20%	0	2/25/2003	
19	22EDLC	EDG Lube Oil Cooler	Yes	On-line 6 Mo	On-line 72 Mo	20%	326	Straight	5.85 ft	0.5 in	.028 in	Titanium SB-338	9.20%	0	2R15	
20	23EDLC	EDG Lube Oil Cooler	Yes	On-line 6 Mo	On-line 72 Mo	20%	326	Straight	5.85 ft	0.5 in	.028 in	Titanium SB-338	9.20%	0	2R15	
21	R-46	Radiation Monitor	Yes	On-line 12 Mo	N/A			Spiral				Titanium SB-338?	0?	0?		
22	R-49	Radiation Monitor	Yes	On-line 12 Mo	N/A			Spiral				Titanium SB-338?	0?	0?		
23	R-53	Radiation Monitor	Yes	On-line 12 Mo	N/A			Spiral				Titanium SB-338?	0?	0?		
24	R-59	Radiation Monitor	No	On-line 12 Mo	N/A			Spiral				Titanium SB-338?	0?	0?		
25	21TLOC	Main Turbine Lube Oil Cooler	No	Outage 24Mo	Outage 24Mo	100%	1,240	Straight	24' - 1"	.625 in	.049 in	90/10 CuNi	10%	75	2R17,2R16, 2R15	No tube plugged in 2R17.

IP2 BOP Heat Exchangers in Eddy Current Program

(For information only)

	MAXIMO Location	Heat Exchanger Description	Safety Related ? (Yes or No)	When PM Inspected (On-line or Outage)	When EC Inspected (On-line or Outage)	Percent of Tubes EC Inspected	Total No. of Tubes	Tube Type (Straight or U-tube)	Straight Length of Tube	Tube O.D., in	Tube BWG	Tube Material	Tube Plugging Limit	No. of Plugged Tubes	Eddy Current History	Comments
26	22TLOC	Main Turbine Lube Oil Cooler	No	Outage 24Mo	Outage 24Mo	100%	1,240	Straight	24' -1"	.625 in	.049 in	Brass	10%	31	2R17,2R16, 2R16	No tube plugged in 2R17.
27	21FPLOC	Main Boiler Feedwater Pump Lube Oil Cooler	No	Outage 24Mo	Outage 72 Mo	25%	182	Straight	7' - 10"	.625 in	.035 in	Titanium	10%	0	2R15	
28	22FPLOC	Main Boiler Feedwater Pump Lube Oil Cooler	No	Outage 24Mo	Outage 72 Mo	25%	182	Straight	7' - 10"	.625 in	.035 in	Titanium	10%	0	2R15	
29	21DGHTEX	Degassing Pump Heat Exchangers	No	Online 36 Mo	Online 72 Mo	100%	110	Straight	8 ft	.750 in	.035 in	Titanium SB-338	10%			
30	22DGHTEX	Degassing Pump Heat Exchangers	No	Online 36 Mo	Online 72 Mo	100%	110	Straight	8 ft	.750 in	.035 in	Titanium SB-338	10%			
31	21IPBHXA	21 Isophase Bus Heat Exchanger	No	Outage 24 Mo	Outage 120 Mo	100%	88	Straight	3 ft	0.625	.035 in.	AL-6XN w/ external fins	10%	0	2R15, 2R16	New cooler installed in R16.
32	22IPBHXA	22 Isophase Bus Heat Exchanger	No	Outage 24 Mo	Outage 120 Mo	100%	88	Straight	3 ft	0.625	.035 in.	AL-6XN w/ external fins	10%	0	2R15, 2R16	New cooler installed in R16.
33	23IPBHXB	23 Isophase Bus Heat Exchanger	No	Outage 24 Mo	Outage 120 Mo	100%	88	Straight	3 ft	0.625	.035 in.	AL-6XN w/ external fins	10%	0	2R15, 2R16	New cooler installed in R16.
34	24IPBHXB	24 Isophase Bus Heat Exchanger	No	Outage 24 Mo	Outage 120 Mo	100%	88	Straight	3 ft	0.625	.035 in.	AL-6XN w/ external fins	10%	0	2R15, 2R16	New cooler installed in R16.
35	25IPBHXC	25 Isophase Bus Heat Exchanger	No	Outage 24 Mo	Outage 120 Mo	100%	88	Straight	3 ft	0.625	.035 in.	AL-6XN w/ external fins	10%	0	2R15, 2R16	New cooler installed in R16.
36	26IPBHXC	26 Isophase Bus Heat Exchanger	No	Outage 24 Mo	Outage 120 Mo	100%	88	Straight	3 ft	0.625	.035 in.	AL-6XN w/ external fins	10%	0	2R15, 2R16	New cooler installed in R16.
37	21AHC	21 North Hydrogen Cooler	No	Outage 24 Mo	Outage 24 Mo	100%	232	Straight	14 ft	.625 in	.049 in	90/10 Cu Ni	10%	0	2R17	No tube plugged; pitted tubes sleeved in 2R17.
38	21BHC	21 South Hydrogen Cooler	No	Outage 24 Mo	Outage 24 Mo	100%	232	Straight	14 ft	.625 in	.049 in	90/10 Cu Ni	10%	0	2R17	No tube plugged; pitted tubes sleeved in 2R17.
39	22AHC	22 North Hydrogen Cooler	No	Outage 24 Mo	Outage 24 Mo	100%	232	Straight	14 ft	.625 in	.049 in	90/10 Cu Ni	10%	0	2R17	No tube plugged; pitted tubes sleeved in 2R17.
40	22BHC	22 South Hydrogen Cooler	No	Outage 24 Mo	Outage 24 Mo	100%	232	Straight	14 ft	.625 in	.049 in	90/10 Cu Ni	10%	0	2R17	No tube plugged; pitted tubes sleeved in 2R17.
41	21CVPHX	21 Condenser Vacuum Pump Heat Exchanger	No	On-line 24 Mo	On-line 96 Mo	100%	184	Straight	12 ft	.625 in	.049 in	316 SS?	10%	0		
42	22CVPHX	22 Condenser Vacuum Pump Heat Exchanger	No	On-line 24 Mo	On-line 96 Mo	100%	184	Straight	12 ft	.625 in	.049 in	316 SS?	10%	0		
43	21THCCSHX	21 Conventional Closed Cooling Heat Exchanger	No	On-line 12 Mo	On-line 24 Mo	100%	282	Straight	24 ft	.625 in	.065 in	Brass	10%	6	1/26/2005	
44	22THCCSHX	22 Conventional Closed Cooling Heat Exchanger	No	On-line 12 Mo	On-line 24 Mo	100%	282	Straight	24 ft	.625 in	.065 in	Brass	10%	1	10/6/2004	
45	SC-21(A)	21 Stator Water Cooler	No	Outage 24 Mo	Outage 72 Mo	100%	688	Straight	12' - 2"	.625 in	.035 in	Titanium	10%	0	2R16	
46	SC-22(B)	22 Stator Water Cooler	No	Outage 24 Mo	Outage 72 Mo	100%	688	Straight	12' - 2"	.625 in	.035 in	Titanium	10%	0	2R16	
47	21A LPH	Low Pressure FW Heater	No	Outage	Outage 72 Mo	10%	1,365	U	44 ft 7-13	0.625	.035 in avg	SS SA-688 Type 304L	10%	5 U	2R15	
48	21B LPH	Low Pressure FW Heater	No	Outage	Outage 72 Mo	10%	1,365	U	44 ft 7-13	0.625	.035 in avg	SS SA-688 Type 304L	10%	4 U	2R17	4U-tubes (8 tubes) plugged previously.

IP2 BOP Heat Exchangers in Eddy Current Program

(For information only)

	MAXIMO Location	Heat Exchanger Description	Safety Related ? (Yes or No)	When PM Inspected (On-line or Outage)	When EC Inspected (On-line or Outage)	Percent of Tubes EC Inspected	Total No. of Tubes	Tube Type (Straight or U-tube)	Straight Length of Tube	Tube O.D., in	Tube BWG	Tube Material	Tube Plugging Limit	No. of Plugged Tubes	Eddy Current History	Comments
49	21C LPH	Low Pressure FW Heater	No	Outage	Outage 72 Mo	10%	1,365	U	44ft 7-13/	0.625	.035 in avg	SS SA-688 Type 304L	10%	3 U	2R16	
50	22A LPH	Low Pressure FW Heater	No	Outage	Outage 72 Mo	10%	1,130	U	33 ft 6-1/1	0.625	.035 in avg	SS SA-688 Type 304L	10%	3 U	2R15	
51	22B LPH	Low Pressure FW Heater	No	Outage	Outage 72 Mo	10%	1,130	U	33 ft 6-1/1	0.625	.035 in avg	SS SA-688 Type 304L	10%	2 U	2R17	2U-tubes (4 tubes) plugged previously.
52	22C LPH	Low Pressure FW Heater	No	Outage	Outage 72 Mo	10%	1,130	U	33 ft 6-1/1	0.625	.035 in avg	SS SA-688 Type 304L	10%	4 U	2R16	
53	23A LPH	Low Pressure FW Heater	No	Outage	Outage 96 Mo	10%	1,112	U	33 ft 10 in	0.625	.035 in avg	SS SA-688 Type 304L	10%	1 U	2R17	1U-tube (2 tubes) plugged previously.
54	23B LPH	Low Pressure FW Heater	No	Outage	Outage 96 Mo	10%	1,112	U	33 ft 10 in	0.625	.035 in avg	SS SA-688 Type 304L	10%	0 U	2R15	
55	23C LPH	Low Pressure FW Heater	No	Outage	Outage 96 Mo	10%	1,112	U	33 ft 10 in	0.625	.035 in avg	SS SA-688 Type 304L	10%			
56	24A LPH	Low Pressure FW Heater	No	Outage	Outage 96 Mo	10%	767	U	36 ft 5 in	0.75	.049 in	SS SA-688 Type 304L	10%	1 U	2R17	1U-tube (2 tubes) plugged previously.
57	24B LPH	Low Pressure FW Heater	No	Outage	Outage 96 Mo	10%	767	U	36 ft 5 in	0.75	.049 in	SS SA-688 Type 304L	10%	0 U	2R15	
58	24C LPH	Low Pressure FW Heater	No	Outage	Outage 96 Mo	10%	767	U	36 ft 5 in	0.75	.049 in	SS SA-688 Type 304L	10%			
59	25A LPH	Low Pressure FW Heater	No	Outage	Outage 96 Mo	10%	1,107	U	32 ft 9 in	0.625	.035 in	SS SA-688 Type 304L	10%	2 U	2R15	
60	25B LPH	Low Pressure FW Heater	No	Outage	Outage 96 Mo	10%	1,107	U	32 ft 9 in	0.625	.035 in avg	SS SA-688 Type 304L	10%	0 U	2R16	
61	25C LPH	Low Pressure FW Heater	No	Outage	Outage 96 Mo	10%	1,107	U	32 ft 9 in	0.625	.035 in avg	SS SA-688 Type 304L	10%			
62	26A HPH	High Pressure FW Heater	No	Outage	Outage 72 Mo	10%	1,685	U	26 ft 4 in	0.625	.042 in (19 B	SS SA-688 Type 304L	10%	2 U, factory installed	2R16	
63	26B HPH	High Pressure FW Heater	No	Outage	Outage 72 Mo	10%	1,685	U	26ft 4 in	0.625	.042 in (19 B	SS SA-688 Type 304L	10%	3 U	2R15	
64	26C HPH	High Pressure FW Heater	No	Outage	Outage 72 Mo	10%	1,685	U	26 ft 4 in	0.625	.042 in (19 B	SS SA-688 Type 304L	10%	1 U	2R17	1 tube plugged in 2R17; no tubes were plugged
65	21A MSR	Moisture Separator Reheater	No	Outage	Outage 48 Mo	25%	573	U	34 ft 9 in	0.75	.058 in nom	439 SS, int. finned	10%	0 U	2R17/2R15	No tube plugged todate.
66	21B MSR	Moisture Separator Reheater	No	Outage	Outage 48 Mo	25%	573	U	34 ft 9 in	0.75	.058 in nom	439 SS, int. finned	10%	33U	2R16	No tube plugged in R16.
67	22A MSR	Moisture Separator Reheater	No	Outage	Outage 48 Mo	25%	573	U	34 ft 9 in	0.75	.058 in nom	439 SS, int. finned	10%	0 U	2R17/2R15	No tube plugged todate.
68	22B MSR	Moisture Separator Reheater	No	Outage	Outage 48 Mo	25%	573	U	34 ft 9 in	0.75	.058 in nom	439 SS, int. finned	10%	1U	2R16	No tube plugged in R16.
69	23A MSR	Moisture Separator Reheater	No	Outage	Outage 48 Mo	25%	573	U	34 ft 9 in	0.75	.058 in nom	439 SS, int. finned	10%	1 U	2R17/2R15	1 U-tube (2 tubes) was plugged previously.
70	23B MSR	Moisture Separator Reheater	No	Outage	Outage 48 Mo	25%	573	U	34 ft 9 in	0.75	.058 in nom	439 SS, int. finned	10%	54U	2R16	1tube (does not allow air to blow through) was plugged in R16.
71	21AWBI, 21AWBO	Main Condenser	No	On-line 12 Mo	On-line 72 Mo	10%	13851	Straight	50'	0.875"	0.028"	Titanium	10%	25	2R17	2R17; 25 tubes plugged todate.
72	21BWBI	Main Condenser	No	On-line 12 Mo	On-line 72 Mo	10%	13851	Straight	50'	0.875"	0.028"	Titanium	10%	39	2R17	2 tubes plugged in 2R17; 39 tubes plugged
73	22AWBI	Main Condenser	No	On-line 12 Mo	On-line 72 Mo	10%	13851	Straight	50'	0.875"	0.028"	Titanium	10%	5	Jun-97	

IP2 BOP Heat Exchangers in Eddy Current Program

(For information only)

	MAXIMO Location	Heat Exchanger Description	Safety Related ? (Yes or No)	When PM Inspected (On-line or Outage)	When EC Inspected (On-line or Outage)	Percent of Tubes EC Inspected	Total No. of Tubes	Tube Type (Straight or U-tube)	Straight Length of Tube	Tube O.D., in	Tube BWG	Tube Material	Tube Plugging Limit	No. of Plugged Tubes	Eddy Current History	Comments
74	22BWBI	Main Condenser	No	On-line 12 Mo	On-line 72 Mo	10%	13851	Straight	50'	0.875"	0.028"	Titanium	10%	9	Jun-97	
75	23AWBI	Main Condenser	No	On-line 12 Mo	On-line 72 Mo	10%	13851	Straight	50'	0.875"	0.028"	Titanium	10%	23	May-05	Leak 3/10/05; tube row 56 tube 1, D, lower bundle, plugged. CR-IP2-05-1049/1051. Ecd on 5-19-05: WO IP3-05-14801
76	23BWBI	Main Condenser	No	On-line 12 Mo	On-line 72 Mo	10%	13851	Straight	50'	0.875"	0.028"	Titanium	10%	8	Jun-97	
77	SJAE Condenser 21	SJAE Condenser 21	No	Outage 15 Yr?	Outage 15 Yr?	100%	153	Straight	6' 5"?	.75"	.035"	304 SS	10%	0	2R17	No tube plugged todate.
78	SJAE Condenser 22	SJAE Condenser 22	No	Outage 15 Yr?	Outage 15 Yr?	100%	153	Straight	6' 5"?	.75"	.035"	304 SS	10%		2R15	
79	Condenser 23	SJAE Condenser 23	No	Outage 15 Yr?	Outage 15 Yr?	100%	153	Straight	6' 5"?	.75"	.035"	304 SS	10%			
80	Gland Steam Condenser	Gland Steam Condenser	No	Outage 10 Yr?	Outage 10 Yr?	100%	496?	Straight?	5' 7"?	.75"?	.035"?	Titanium	10%			
81	MIFDS (SEAL TABLE)	RPV Incore Thimble Tubes		Outage 8 Yr?	Outage 4 Yr?	100%	58		113'	.385"?	.059"?	316 SS?	N/A			

Note: This table is for general information purpose only. Some of the items such as PM/EC frequency, percent of tubes to be inspected, number of tubes plugged, eddy current history, etc., are subject to change on an on-going basis. Contact the Component Engineer for latest information.

IP3 BOP Heat Exchangers in Eddy Current Program

(For information only)

	MAXIMO Location	Heat Exchanger Description	Safety Related? (Yes or No)	When PM Inspected (On-line or Outage)	When EC Inspected (On-line or Outage)	Percent of Tubes EC Inspected	Total No. of Tubes	Tube Type (Straight or U-tube)	Straight Length of Tube	Tube O.D., in	Tube BWG	Tube Material	Tube Plugging Limit	No. of plugged tubes	Eddy Current History	Comments
1	ACAHCC1	Component Cooling Water HX 31	Yes	On-line 24 Mo	On-line 24 Mo	50%	2706	Straight	19.35'	0.625	18 (.049")	Admiralty, SB 111	20% (i.e. 541 tubes, per IP3-CALC-CCW-02487)	8	3/14/2006	1 tube plugged on 3-14-06.
2	ACAHCC2	Component Cooling Water HX 32	Yes	On-line 24 Mo	On-line 24 Mo	50%	2706	Straight	19.35'	0.625	18 (.049")	Admiralty, SB 111	20% (i.e. 541 tubes, per IP3-CALC-CCW-02487)	22	11/8/2005	5 tubes are plugged on 11-8-05.
3	CRF1(COOL HTX)	Fan Cooler Unit #31	Yes	On-line 60 Mo	On-line 240 Mo	100%	768 U-tubes (96/coil; 8 coils/unit)	U-tubes	10.42'	0.625	22 (.028")	AL-6X SS, w/.008 cu fins	4% max, per WCAP-12313; i.e., 31 U-tubes	1U (2 tubes)		
4	CRF2(COOL HTX)	Fan Cooler Unit #32	Yes	On-line 60 Mo	On-line 240 Mo	100%	768 U-tubes (96/coil; 8 coils/unit)	U-tubes	10.42'	0.625	22 (.028")	AL-6X SS, w/.008 cu fins	4% max, per WCAP-12313; i.e., 31 U-tubes	4U (8tubes)	12/7/2005; sat, no additional plugging.	No tubes plugged in 2005.
5	CRF3(COOL HTX)	Fan Cooler Unit #33	Yes	On-line 60 Mo	On-line 240 Mo	100%	768 U-tubes (96/coil; 8 coils/unit)	U-tubes	10.42'	0.625	22 (.028")	AL-6X SS, w/.008 cu fins	4% max, per WCAP-12313; i.e., 31 U-tubes	1U (2 tubes)	6/3/2003;	
6	CRF4(COOL HTX)	Fan Cooler Unit #34	Yes	On-line 60 Mo	On-line 240 Mo	100%	768 U-tubes (96/coil; 8 coils/unit)	U-tubes	10.42'	0.625	22 (.028")	AL-6X SS, w/.008 cu fins	4% max, per WCAP-12313; i.e., 31 U-tubes	20 U-tubes (40 tubes)		
7	CRF5(COOL HTX)	Fan Cooler Unit #35	Yes	On-line 60 Mo	On-line 240 Mo	100%	768 U-tubes (96/coil; 8 coils/unit)	U-tubes	10.42'	0.625	22 (.028")	AL-6X SS, w/.008 cu fins	4% max, per WCAP-12313; i.e., 31 U-tubes	26 U-tubes (52 tubes)		Mismatched tube plugs 8 (4 U-tubes); CR IP3-03-06412)
8	CRF1 MOT HTX	Fan Cooler Unit Motor Cooler #31	Yes	On-line 60 Mo	On-line 240 Mo	100%	48 U-tubes	U-tubes	2.50'	0.625	20 (.035")	AL-6X SS	10% max, per WCAP-12313	0		
9	CRF2 MOT HTX	Fan Cooler Unit Motor Cooler #32	Yes	On-line 60 Mo	On-line 240 Mo	100%	48 U-tubes	U-tubes	2.50'	0.625	20 (.035")	AL-6X SS	10% max, per WCAP-12313	0	12-7-05; sat	
10	CRF3 MOT HTX	Fan Cooler Unit Motor Cooler #33	Yes	On-line 60 Mo	On-line 240 Mo	100%	48 U-tubes	U-tubes	2.50'	0.625	20 (.035")	AL-6X SS	10% max, per WCAP-12313	0	6-3-03; IP3-02-19315/6	
11	CRF4 MOT HTX	Fan Cooler Unit Motor Cooler #34	Yes	On-line 60 Mo	On-line 240 Mo	100%	48 U-tubes	U-tubes	2.50'	0.625	20 (.035")	AL-6X SS	10% max, per WCAP-12313	0		
12	CRF5 MOT HTX	Fan Cooler Unit Motor Cooler #35	Yes	On-line 60 Mo	On-line 240 Mo	100%	48 U-tubes	U-tubes	2.50'	0.625	20 (.035")	AL-6X SS	10% max, per WCAP-12313	0		
13	CCR A.C. UNIT 31; ACU31 HTX (A/B)	CRAC Cooler #31	Yes	On-line 9 Mo	On-line 36 Mo	100%	31A: 20 tubes, 31B: 20 tubes	Straight	3.5'	0.75	20 (.035")	Copper	0, per DC 96-3-129 CRHV	0	7-22-03, IP3-02-22223/4	
14	CCR A.C. UNIT 32; ACU32 HTX (A/B)	CRAC Cooler #32	Yes	On-line 9 Mo	On-line 36 Mo	100%	32A: 20 tubes, 32B: 20 tubes	Straight	3.5'	0.75	20 (.035")	Copper	0, per DC 96-3-129 CRHV	0	12-15-04, IP3-02-22225/6	
15	EDG-31-JW HTX	EDG Jacket Water Cooler #31	Yes	On-line 12 Mo	On-line 36 Mo	100%	506	Straight	4.50'	0.375	22 (.028")	Admiralty brass	15 tubes per NSE 93-3-114 EDG	1	8-5-03; IP3-02-20733	
16	EDG-32-JW HTX	EDG Jacket Water Cooler #32	Yes	On-line 12 Mo	On-line 36 Mo	100%	506	Straight	4.50'	0.375	22 (.028")	Admiralty brass	15 tubes per NSE 93-3-114 EDG	0	9-2-03; IP3-02-20739	
17	EDG-33-JW HTX	EDG Jacket Water Cooler #33	Yes	On-line 12 Mo	On-line 36 Mo	100%	506	Straight	4.50'	0.375	22 (.028")	Admiralty brass	15 tubes per NSE 93-3-114 EDG	0		
18	EDG-31-LO HTX	EDG Lube Oil Cooler #31	Yes	On-line 12 Mo	On-line 36 Mo	100%	182	Straight	4.50'	0.625	18 (.049")	Admiralty brass	12 tubes per NSE 93-3-114 EDG	0		
19	EDG-32-LO HTX	EDG Lube Oil Cooler #32	Yes	On-line 12 Mo	On-line 36 Mo	100%	182	Straight	4.50'	0.625	18 (.049")	Admiralty brass	12 tubes per NSE 93-3-114 EDG	0		
20	EDG-33-LO HTX	EDG Lube Oil Cooler #33	Yes	On-line 12 Mo	On-line 36 Mo	100%	182	Straight	4.50'	0.625	18 (.049")	Admiralty brass	12 tubes per NSE 93-3-114 EDG	0		

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9/7/2006

IP3 BOP Heat Exchangers in Eddy Current Program

(For information only)

	MAXIMO Location	Heat Exchanger Description	Safety Related? (Yes or No)	When PM Inspected (On-line or Outage)	When EC Inspected (On-line or Outage)	Percent of Tubes EC Inspected	Total No. of Tubes	Tube Type (Straight or U-tube)	Straight Length of Tube	Tube O.D., in	Tube BWG	Tube Material	Tube Plugging Limit	No. of plugged tubes	Eddy Current History	Comments
21	TURB LO 31 HTX	Main Turbine Lube Oil Cooler #31	No	Outage 24Mo	Outage 24Mo	100%	1240	Straight	24'	0.625"	0.049"	Brass	10%	49	3R13	3R13; 3-23-05; SAT; CR-IP#-05-01441; 48 tubes plugged.
22	TURB LO 32 HTX	Main Turbine Lube Oil Cooler #32	No	Outage 24Mo	Outage 24Mo	100%	1240	Straight	24'	0.625"	0.049"	Brass	10%	22	3R13	SAT; no tube plugging in R13.
23	MBFP OIL COOLER 31	Main Boiler Feed Pump Lube Oil Cooler #31	No	Outage 24Mo	Outage 24Mo	100%	182	Straight	8'	0.625"	0.049"	Brass	10%	0	3R13	SAT; no tube plugging in R13.
24	MBFP OIL COOLER 32	Main Boiler Feed Pump Lube Oil Cooler #32	No	Outage 24Mo	Outage 24Mo	100%	182	Straight	8'	0.625"	0.049"	Brass	10%	0	3R13	UNSAT; cooler retubed w/ new brass bundle WO IP3-05-15020; baseline inspected.
25	SWN CLC 31 HTX	Instrument Air Closed Cooling HX #31	No	On-line 24 Mo	On-line 24 Mo	100%	62	Straight	6' 11"	0.625"	18 (.049")	Brass	0%, per NED-M-94-WP51-NH1015	0	12-21-05; 2-3-04, IP3-02-20961	
26	SWN CLC 32 HTX	Instrument Air Closed Cooling HX #32	No	On-line 24 Mo	On-line 24 Mo	100%	62	Straight	6' 11"	0.625"	18 (.049")	Brass	0%, per NED-M-94-WP51-NH1015	0	8-28-06, IP3-04-17400;8-5-04, IP3-02-19117	11 tubes showed pitting. However, they are still within acceptable limits; it is recommended that at the next PM the HTX tube bundle be replaced.
27	ISO PH BUS 31 HTX	Isophase Bus Duct Cooler #31	No	On-line 24 Mo	On-line 24 Mo	100%	East - 48, West - 48	Straight	8'	0.625"	.035"	90/10 Cu-Ni	10%	East - 0, West - 0	3R13	
28	ISO PH BUS 32 HTX	Isophase Bus Duct Cooler #32	No	On-line 24 Mo	On-line 24 Mo	100%	East - 48, West - 48	Straight	8'	0.625"	.035"	90/10 Cu-Ni	10%	East - 4, West - 0	3R13	Note: No tube plugging is permitted in th
29	ISO PH BUS 33 HTX	Isophase Bus Duct Cooler #33	No	On-line 24 Mo	On-line 24 Mo	100%	East - 48, West - 48	Straight	8'	0.625"	.035"	90/10 Cu-Ni	10%	East - 5, West - 2	3R13	SAT; no tube plugging in R13.
30	H2-31 HTX	Hydrogen Cooler #31	No	Outage 24 Mo	Outage 240 Mo	100%	288	Straight	14.75'	.875"	.049"	AL-6XN SS	10%	0	3R13	Replaced w/ AL-6X in R12.
31	H2-32 HTX	Hydrogen Cooler #32	No	Outage 24 Mo	Outage 240 Mo	100%	288	Straight	14.75'	.875"	.049"	AL-6XN SS	10%	0	3R13	Replaced w/ AL-6X in R12.
32	H2-33 HTX	Hydrogen Cooler #33	No	Outage 24 Mo	Outage 240 Mo	100%	288	Straight	14.75'	.875"	.049"	AL-6XN SS	10%	0	3R13	Replaced w/ AL-6X in R12.
33	H2-34 HTX	Hydrogen Cooler #34	No	Outage 24 Mo	Outage 240 Mo	100%	288	Straight	14.75'	.875"	.049"	AL-6XN SS	10%	0	3R13	Replaced w/ AL-6X in R12.
34	HSOS H2 HTX	Hydrogen Side Seal Oil Cooler	No	Outage 24 Mo	Outage 24 Mo	100%	146	Straight	9'	0.625"	18 (.049")	Brass (Admiralty)	10%	1	3R13	SAT; one tube plugged in R13 based on shell side leak test.
35	HSOS AIR HTX	Air Side Seal Oil Cooler, 4 air side coolers - A (top), B, C, D (bottom)	No	Outage 24 Mo	Outage 24 Mo	100%	A - 128, B - 128, C - 128, D - 128	Straight	7' 5"	0.625"	18 (.049")	Brass	10%	A - 8, B - 0, C - 0, D - 5	3R13	Cooler A (top) - one tube plugged; others no tubes plugged in R13.
36	SWT CLC 31 HTX	Turbine Hall Closed Cooling HX #31	No	On-line 6 Mo	On-line 24 Mo	100%	282	Straight	24'	0.625"	.065"	Brass	10%	0	10/12/2005	
37	SWT CLC 32 HTX	Turbine Hall Closed Cooling HX #32	No	On-line 6 Mo	On-line 24 Mo	100%	282	Straight	24'	0.625"	.065"	Brass	10%	0	12/7/2005	
38	SGBDHX-3	Steam Gen Blowdown HX 3	No	On-line 72 Mo	On-line 120 Mo	100%	189 U-tubes	U-tube	19' 6"	0.625"	.065"	439 SS	10%	0		
39	SGBDHX-4A	Steam Gen Blowdown HX 4A	No	On-line 48 Mo	On-line 192 Mo	100%	208 U-tubes	U-tube	16' 7"	0.625"	.065"	AL-6X SS	10%	0		HTX installed in 1989; SW cooled.
40	SGBDHX-4B	Steam Gen Blowdown HX 4B	No	On-line 48 Mo	On-line 192 Mo	100%	208 U-tubes	U-tube	16' 7"	0.625"	.065"	AL-6X SS	10%	0		HTX installed in 1989; SW cooled.
41	31 EXCITER AIR COOLER	31 Exciter Air Cooler	No	Outage 24 Mo	Outage 24 Mo	100%	50	Straight	6'	1.00"	0.049"	Brass	10%	0	3R13	SAT; no tube plugging in R13.

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9/7/2006

IP3 BOP Heat Exchangers in Eddy Current Program

(For information only)

	MAXIMO Location	Heat Exchanger Description	Safety Related? (Yes or No)	When PM Inspected (On-line or Outage)	When EC Inspected (On-line or Outage)	Percent of Tubes EC Inspected	Total No. of Tubes	Tube Type (Straight or U-tube)	Straight Length of Tube	Tube O.D., in	Tube BWG	Tube Material	Tube Plugging Limit	No. of plugged tubes	Eddy Current History	Comments
42	32 EXCITER AIR COOLER	32 Exciter Air Cooler	No	Outage 24 Mo	Outage 24 Mo	100%	50	Straight	6'	1.00"	0.049"	Brass	10%	1	3R13	SAT; no tube plugging in R13.
43	FWH-31A HTX	Feedwater Heater 31A	No	Outage 8 Yr	Outage 24 Mo	15%	1311 U-tubes	U-tube	41' 5"	.625"	.035"	439 SS	10%	41 U	3R13	SAT; 3 U-tubes were plugged in R13.
44	FWH-31B HTX	Feedwater Heater 31B	No	Outage 8 Yr	Outage 24 Mo	15%	1311 U-tubes	U-tube	41' 5"	.625"	.035"	439 SS	10%	42 U	3R13	SAT; no tube plugging in R13.
45	FWH-31C HTX	Feedwater Heater 31C	No	Outage 8 Yr	Outage 24 Mo	15%	1311 U-tubes	U-tube	41' 5"	.625"	.035"	439 SS	10%	58 U	3R13	SAT; no tube plugging in R13.
46	FWH-32A HTX	Feedwater Heater 32A	No	Outage 8 Yr	Outage 8 Yr	10-15%	1117 U-tubes	U-tube	29' 5"	.625"	.035"	439 SS	10%	0	3R13	SAT; no tube plugging in R13.
47	FWH-32B HTX	Feedwater Heater 32B	No	Outage 8 Yr	Outage 8 Yr	10-15%	1117 U-tubes	U-tube	29' 5"	.625"	.035"	439 SS	10%			
48	FWH-32C HTX	Feedwater Heater 32C	No	Outage 8 Yr	Outage 8 Yr	10-15%	1117 U-tubes	U-tube	29' 5"	.625"	.035"	439 SS	10%			
49	FWH-33A HTX	Feedwater Heater 33A	No	Outage 8 Yr	Outage 8 Yr	10-15%	834 U	U-tube	36' 6"	0.75"	0.035"	439 SS	10%			
50	FWH-33B HTX	Feedwater Heater 33B	No	Outage 8 Yr	Outage 8 Yr	10-15%	834 U	U-tube	36' 6"	0.75"	0.035"	439 SS	10%	0	3R13	SAT; no tube plugging in R13.
51	FWH-33C HTX	Feedwater Heater 33C	No	Outage 8 Yr	Outage 8 Yr	10-15%	834 U	U-tube	36' 6"	0.75"	0.035"	439 SS	10%			
52	FWH-34A HTX	Feedwater Heater 34A	No	Outage 8 Yr	Outage 8 Yr	15-20%	660 U	U-tube	35' 4"	.875"	.035"	439 SS	10%			
53	FWH-34B HTX	Feedwater Heater 34B	No	Outage 8 Yr	Outage 8 Yr	15-20%	661 U	U-tube	35' 4"	.875"	.035"	439 SS	10%			
54	FWH-34C HTX	Feedwater Heater 34C	No	Outage 8 Yr	Outage 8 Yr	15-20%	662 U	U-tube	35' 4"	.875"	.035"	439 SS	10%			
55	FWH-35A HTX	Feedwater Heater 35A	No	Outage 6 Yr	Outage 6 Yr	15-20%	1070 U	U-tube	34' 8"	0.75"	0.035"	439 SS	10%			
56	FWH-35B HTX	Feedwater Heater 35B	No	Outage 6 Yr	Outage 6 Yr	15-20%	1070 U	U-tube	34' 8"	0.75"	0.035"	439 SS	10%	4 U	3R13	SAT; no tube plugging in R13.
57	FWH-35C HTX	Feedwater Heater 35C	No	Outage 6 Yr	Outage 6 Yr	15-20%	1071 U	U-tube	34' 8"	0.75"	0.035"	439 SS	10%			
58	FWH-36A HTX	Feedwater Heater 36A	No	Outage	Outage 6 Yr	20-25%	1829 U	U-tube	33'-4"	0.625	18 (.049")	439 SS	10%	13 U	3R13	SAT; no tube plugging in R13.
59	FWH-36B HTX	Feedwater Heater 36B	No	Outage	Outage 6 Yr	20-25%	1829 U	U-tube	33'-4"	0.625	18 (.049")	439 SS	10%	14 U		
60	FWH-36C HTX	Feedwater Heater 36C	No	Outage	Outage 6 Yr	20-25%	1829 U	U-tube	33'-4"	0.625	18 (.049")	439 SS	10%	27 U		
61	31A MSR	Moisture Separator Reheater 31A	No	Outage 4 Yr	Outage 6 Yr	25%	573 U	U-tube	36'	.75"	.065"	439 SS	10%			Switched w/ MSR 33B in 3R13, per mtc. request.
62	31B MSR	Moisture Separator Reheater 31B	No	Outage 4 Yr	Outage 6 Yr	25%	573 U	U-tube	36'	.75"	.065"	439 SS	10%			
63	32A MSR	Moisture Separator Reheater 32A	No	Outage 4 Yr	Outage 6 Yr	25%	573 U	U-tube	36'	.75"	.065"	439 SS w/ integral fins	10%			
64	32B MSR	Moisture Separator Reheater 32B	No	Outage 4 Yr	Outage 6 Yr	25%	573 U	U-tube	36'	.75"	.065"	439 SS w/ integral fins	10%	3 U	3R13	SAT; no tube plugging in R13.
65	33A MSR	Moisture Separator Reheater 33A	No	Outage 4 Yr	Outage 6 Yr	25%	573 U	U-tube	36'	.75"	.065"	439 SS w/ integral fins	10%			

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9/7/2006

IP3 BOP Heat Exchangers in Eddy Current Program

(For information only)

	MAXIMO Location	Heat Exchanger Description	Safety Related? (Yes or No)	When PM Inspected (On-line or Outage)	When EC Inspected (On-line or Outage)	Percent of Tubes EC Inspected	Total No. of Tubes	Tube Type (Straight or U-tube)	Straight Length of Tube	Tube O.D., in	Tube BWG	Tube Material	Tube Plugging Limit	No. of plugged tubes	Eddy Current History	Comments
66	33B MSR	Moisture Separator Reheater 33B	No	Outage 4 Yr	Outage 6 Yr	25%	573 U	U-tube	36'	.75"	.065"	439 SS w/ integral fins	10%	1U	3R13	SAT; no tube plugging in R13.
67	CONDENSER 31	31 Main Condenser Waterbox 31	No	On-line 12 Mo	Outage 72 Mo	10%	12,553	Straight	49' 11"	.875"/.875"	.028"/.072"	Titanium	10%	28 (11 lower, 17 upper)	3R13	SAT; no tube plugging in R13.
68	CONDENSER 31	31 Main Condenser Waterbox 32	No	On-line 12 Mo	Outage 72 Mo	10%	12,553	Straight	49' 11"	.875"/.875"	.028"/.072"	Titanium	10%	33 (11 lower, 22 upper)	3R13	SAT; 1 blocked tube in UR periphery plugged in R13.
69	CONDENSER 32	32 Main Condenser Waterbox 33	No	On-line 12 Mo	Outage 72 Mo	10%	12,553	Straight	49' 11"	.875"/.875"	.028"/.072"	Titanium	10%	14 (8 lower, 6 upper)	3R12 ?	
70	CONDENSER 32	32 Main Condenser Waterbox 34	No	On-line 12 Mo	Outage 72 Mo	10%	12,553	Straight	49' 11"	.875"/.875"	.028"/.072"	Titanium	10%	25	3R11?	
71	CONDENSER 33	33 Main Condenser Waterbox 35	No	On-line 12 Mo	Outage 72 Mo	10%	12,553	Straight	49' 11"	.875"/.875"	.028"/.072"	Titanium	10%	27	3R12 ?	
72	CONDENSER 33	33 Main Condenser Waterbox 36	No	On-line 12 Mo	Outage 72 Mo	10%	12,553	Straight	49' 11"	.875"/.875"	.028"/.072"	Titanium	10%	27	3R12 ?	
73	SJAEC31 HTX	31 Steam Jet Air Ejector Condenser	No	Outage 15 Yr	Outage 15 Yr	100%	153	Straight	6' 5"	.75"	.035"	304 SS	10%	0	May-92	
74	SJAEC32 HTX	32 SJAE Condenser	No	Outage 15 Yr	Outage 15 Yr	100%	153	Straight	6' 5"	.75"	.035"	305 SS	10%	0	R10	
75	SJAEC33 HTX	33 SJAE Condenser	No	Outage 15 Yr	Outage 15 Yr	100%	153	Straight	6' 5"	.75"	.035"	306 SS	10%	0	R12	
76	Gland Steam Condenser (GSC-31)	Gland Steam Condenser (GSC-31)	No	Outage 10 Yr	Outage 10 Yr	100%	496	Straight?	5' 7"	.75"	.065"	439 SS	10%	0	R12	
77	SEAL TABLE	RPV Incore Thimble Tubes		Outage 8 yr	Outage 4 Yr	100%	58		113'	.385"	.059"	316 SS	N/A	N/A	R11	

Note: This table is for general information purpose only. Some of the items such as PM/EC frequency, percent of tubes to be inspected, number of tubes plugged, eddy current history, etc., are subject to change on an on-going basis. Contact the Component Engineer for latest information.

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9/7/2006

IP2 EDDY CURRENT PROGRAM - TUBE PLUGGING CRITERIA

(FOR SAFETY-RELATED HEAT EXCHANGERS)

SUMMARY				
Heat Exchanger	**References**	**Allowable Wall Loss (%)**	**Eddy Current Sizing Error (%)**	**Plugging Criteria (% or More Wall Loss) ***
Fan Cooler Units 21 - 25 (1392 tubes, .625" OD, .028" thk., AL6X)	IP2-EC-GUIDELINE NO. 1, Rev. 1	72%	-10%	62%
FCU Motor Coolers 21 - 25 (128 tubes, .625" OD, .028" thk., AL6X)	IP2-EC-GUIDELINE NO. 1, Rev. 1	72%	-10%	62%
Component Cooling HXs. 21 & 22 (1750 tubes, .75" OD, .049" thk., 90/10 Cu-Ni)	IP2-EC-GUIDELINE NO. 1, Rev. 1	67%	-10%	57%
EDG Jacket Water Coolers 21 - 23 (886 tubes; .375" OD, .028" thk., Titanium)	IP2-EC-GUIDELINE NO. 1, Rev. 1	80%	-10%	70%
EDG Lube Oil Coolers 21 - 23 (326 tubes; .5" OD, .028" thk., Titanium)	IP2-EC-GUIDELINE NO. 1, Rev. 1	80%	-10%	70%
IA Closed Cooling HXs. 21 & 22 (62 tubes, .625" OD, .065" thk., Admiralty Brass)	IP2-EC-GUIDELINE NO. 1, Rev. 1	73%	-10%	63%
* NOTE: These values are intended for guidance in tube plugging as a precautionary measure; higher wall loss may be acceptable for past operability determinations per Ref. 3.11, and/or as determined by engineering. Tube plugging limit (i.e., maximum number of tubes that may be plugged) is given in Appendix 1.				

IP2 EDDY CURRENT PROGRAM - TUBE PLUGGING CRITERIA

(FOR NON SAFETY-RELATED HEAT EXCHANGERS)

SUMMARY				
Heat Exchanger	**References**	**Allowable Wall Loss (%)**	**Eddy Current Sizing Error (%)**	**Plugging Criteria (% or More Wall Loss) ***
Hydrogen Coolers 21&22 North; 21&22 South (232 tubes, .625" OD, .049" thk., 90/10 Cu-Ni)	IP2-EC-GUIDELINE NO. 1, Rev. 1	84%	-10%	74%
Main Boiler Feed Pump Lube Oil Coolers 21 & 22 (182 tubes, .625" OD, .035" thk., Titanium)	IP2-EC-GUIDELINE NO. 1, Rev. 1	86%	-10%	76%
Main Turbine Lube Oil Cooler #21 (1,240 tubes, .625" OD, .049" thk., 90/10 Cu-Ni)	IP2-EC-GUIDELINE NO. 1, Rev. 1	84%	-10%	74%
Main Turbine Lube Oil Cooler #22 (1,240 tubes, .625" OD, .049" thk., Brass)	IP2-EC-GUIDELINE NO. 1, Rev. 1	82%	-10%	72%
Moisture Separator Reheaters 21A/B, 22A/B & 23A/B (573 U-tubes, .75" OD, .058" thk., 439 SS)	IP2-EC-GUIDELINE NO. 1, Rev. 1	68%	-10%	58%
Feedwater Heaters 26A, 26B, 26C (1,685 U-tubes, .625" OD, .035" thk., SA-688 Type 304L)	IP2-EC-GUIDELINE NO. 1, Rev. 1	69%	-10%	59%
Feedwater Heaters 25A, 25B, 25C (1,107 U-tubes, .625" OD, .035" thk., SA-688 Type 304L)	IP2-EC-GUIDELINE NO. 1, Rev. 1	69%	-10%	59%
Isophase Bus Duct Coolers 21 - 26 (88 tubes, .625" OD, .049" thk., AL-6XN)	IP2-EC-GUIDELINE NO. 1, Rev. 1	84%	-10%	74%
Turbine Hall Closed Coolers 21 & 22 (THCCSHX) (282 tubes, .625" OD, .065" thk., Brass)	IP2-EC-GUIDELINE NO. 1, Rev. 1	82%	-10%	72%
Feedwater Heaters 21A, 21B, 21C (1,366 U-tubes, .625" OD, .035" thk., SA-688 Type 304L)	IP2-EC-GUIDELINE NO. 1, Rev. 1	69%	-10%	59%
Feedwater Heaters 22A, 22B, 22C (1,130 U-tubes, .625" OD, .035" thk., SA-688 Type 304L)	IP2-EC-GUIDELINE NO. 1, Rev. 1	69%	-10%	59%
Feedwater Heaters 23A, 23B, 23C (1,112 U-tubes, .625" OD, .035" thk., SA-688 Type 304L)	IP2-EC-GUIDELINE NO. 1, Rev. 1	69%	-10%	59%
Feedwater Heaters 24A, 24B, 24C (767 U-tubes, .75" OD, .049" thk., SA-688 Type 304)	IP2-EC-GUIDELINE NO. 1, Rev. 1	69%	-10%	59%
Stator Water Coolers 21 & 22 (688 tubes, .625" OD, .035" thk., Titanium)	IP2-EC-GUIDELINE NO. 1, Rev. 1	86%	-10%	76%
Degasing Pump Hxs. 21 & 22 (110 tubes, .75" OD, .035" thk., Titanium SB-338)	IP2-EC-GUIDELINE NO. 1, Rev. 1	86%	-10%	76%
Condenser Vacuum Pump Hxs 21 & 22 (184 tubes, .625" OD, .049" thk., 316 SS)	IP2-EC-GUIDELINE NO. 1, Rev. 1	84%	-10%	74%
Main Condenser Waterboxes 21A/B, 22A/B &23A/B (13,837 tubes/waterbox, .875" OD, .028" thk., Titanium)	IP2-EC-GUIDELINE NO. 1, Rev. 1	85%	-10%	75%
Gland Steam Condenser (400 tubes, .75" OD, .049" thk., Titanium)	IP2-EC-GUIDELINE NO. 1, Rev. 1	81%	-10%	71%
SJAE Condensers 21, 22 & 23 (153 tubes, .75" OD, .035" thk., 304 SS)	IP2-EC-GUIDELINE NO. 1, Rev. 1	83%	-10%	73%
* NOTE: These values are intended for guidance in tube plugging as a precautionary measure; higher wall loss may be acceptable for past operability determinations per Ref. 3.11, and/or as determined by engineering. Tube plugging limit (i.e., maximum number of tubes that may be plugged) is given in Appendix 1.				

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8/14/2006

IP3 EDDY CURRENT PROGRAM - TUBE PLUGGING CRITERIA

(FOR SAFETY-RELATED HEAT EXCHANGERS)

SUMMARY

Heat Exchangers (safety related)	References	Allowable Wall Loss (%)	Eddy Current Sizing Error (%)	Plugging Criteria (% or More Wall Loss) *
Fan Cooler Units 31 - 35 (768 U-tubes, .625" OD, .028" thk., AL-6X)	IP3-CALC-MULT-00928, Rev. 0	57%	-10%	47%
FCU Motor Coolers 31 - 35 (48 U-tubes, .625" OD, .035" thk., AL-6X)	IP3-RPT-UNSPEC-03498, Rev. 1	72%	-10%	62%
Component Cooling HXs. 31 & 32 (2,706 tubes, .625" OD, .049" thk., Admiralty Brass SB-111)	IP3-CALC-MULT-00928, Rev. 0	65%	-10%	55%
EDG JW Coolers 31 - 33 (506 tubes, .375" OD, .028" thk., Admiralty Brass)	IP3-CALC-MULT-00928, Rev. 0	65%	-10%	55%
EDG LO Coolers 31 - 33 (182 tubes, .625" OD, .049" thk., Admiralty Brass)	IP3-CALC-MULT-00928, Rev. 0	65%	-10%	55%
CRAC Coolers 31 & 32 (20 tubes each in A/B, .75" OD, .035" thk., Copper)	IP3-CALC-CRHV-02418, Rev. 0	26%	-10%	16%

* NOTE: These values are intended for guidance in tube plugging as a precautionary measure; higher wall loss may be acceptable for past operability determinations per Ref. 3.11, and/or as determined by engineering. Tube plugging limit (i.e., maximum number of tubes that may be plugged) is given in Appendix 2.

IP3 EDDY CURRENT PROGRAM - TUBE PLUGGING CRITERIA

(FOR NON SAFETY-RELATED HEAT EXCHANGERS)

SUMMARY

Heat Exchangers (non-safety related)	References	Allowable Wall Loss (%)	Eddy Current Sizing Error (%)	Plugging Criteria (% or More Wall Loss) *
Air Side Seal Oil Coolers A (top), B, C & D (128 tubes in each, .625" OD, .049" thk., Brass)	IP3-RPT-UNSPEC-03498, Rev. 1	76%	-10%	66%
Hydrogen Coolers 31 - 34 (288 tubes, .875" OD, .049" thk., AL-6XN)	IP3-RPT-UNSPEC-03498, Rev. 1	84%	-10%	74%
Main Condenser Waterboxes 31 - 36 (12,553 tubes, .875"OD, .028"/.072" thk., Titanium)	IP3-RPT-UNSPEC-03498, Rev. 1	85%	-10%	75%
Main Boiler Feed Pump Lube Oil Coolers 31, 32 (182 tubes, .625" OD, .049" thk., Brass)	IP3-RPT-UNSPEC-03498, Rev. 1	79%	-10%	69%
Main Turbine Lube Oil Coolers 31, 32 (1,240 tubes, .625" OD, .049" thk., Brass)	IP3-RPT-UNSPEC-03498, Rev. 1	79%	-10%	69%
Main Exciter Air Coolers 31, 32 (50 tubes, 1" OD, .049" thk., Brass)	IP3-RPT-UNSPEC-03498, Rev. 1	79%	-10%	69%
Moisture Separator Reheaters 31A/B, 32A/B, 33A/B (573 U-tubes, .75" OD, .065" thk., 439 SS)	IP3-RPT-UNSPEC-03498, Rev. 1	68%	-10%	58%
Feedwater Heaters 36A, 36B, 36C (1,829 U-tubes, .625" OD, .049" thk., 439 SS)	IP3-RPT-UNSPEC-03498, Rev. 1	69%	-10%	59%
Feedwater Heaters 35A, 35B, 35C (1,070 U-tubes, .75" OD, .035" thk., 439 SS)	IP3-RPT-UNSPEC-03498, Rev. 1	69%	-10%	59%
Isophase Bus Duct Coolers 31 - 33 (48 tubes each in East and West, .625" OD, .035" thk., 90/10 Cu-Ni)	IP3-RPT-UNSPEC-03498, Rev. 1	79%	-10%	69%
Turbine Hall Closed Cooling Water (THCC) 31, 32 (282 tubes, .625" OD, .065" thk., Brass)	IP3-RPT-UNSPEC-03498, Rev. 1	82%	-10%	72%
Feedwater Heaters 31A, 31B, 31C (1,311 U-tubes, .625" OD, .035" thk., 439 SS)	IP3-RPT-UNSPEC-03498, Rev. 1	66%	-10%	56%
Feedwater Heaters 32A, 32B, 32C (1,117 U-tubes, .625" OD, .035" thk., 439SS)	IP3-RPT-UNSPEC-03498, Rev. 1	69%	-10%	59%
Hydrogen Side Seal Oil Cooler (146 tubes, .625" OD, .049" thk., Ad. Brass)	IP3-RPT-UNSPEC-03498, Rev. 1	76%	-10%	66%
Feedwater Heaters 33A, 33B, 33C (834 U-tubes, .75" OD, .035" thk., 439 SS)	IP3-RPT-UNSPEC-03498, Rev. 1	69%	-10%	59%
Feedwater Heaters 34A, 34B, 34C (660 U-tubes, .875" OD, .035" thk., 439 SS)	IP3-RPT-UNSPEC-03498, Rev. 1	69%	-10%	59%
Gland Steam Condenser (GSC-31) (496 tubes, .75" OD, .065" thk., 439 SS)	IP3-RPT-UNSPEC-03498, Rev. 1	73%	-10%	63%
SGBDHX-3 (189 U-tubes, .625" OD, .065" thk., 439 SS)	IP3-RPT-UNSPEC-03498, Rev. 1	77%	-10%	67%
SGBDHX-4A (208 U-tubes, .625" OD, .065" thk., AL-6XN)	IP3-RPT-UNSPEC-03498, Rev. 1	73%	-10%	63%
SGBDHX-4B (208 U-tubes, .625" OD, .065" thk., AL-6XN)	IP3-RPT-UNSPEC-03498, Rev. 1	73%	-10%	63%
SGBDHX-1 (22 U-tubes, 5/8" OD, .083" thk., AL-6XN)	IP3-RPT-UNSPEC-03498, Rev. 1	69%	-10%	59%
SJAE Condensers 31, 32, 33 (153 tubes, .75" OD, .035" thk., 304 SS)	IP3-RPT-UNSPEC-03498, Rev. 1	83%	-10%	73%
IA Closed Cooling Water HXs, 31, 32 (62 tubes, .625" OD, .049" thk., Admiralty Brass)	IP3-CALC-MULT-00929, Rev. 0	65%	-10%	55%

* NOTE: These values are intended for guidance in tube plugging as a precautionary measure; higher wall loss may be acceptable for past operability determinations per Ref. 3.11, and/or as determined by engineering. Tube plugging limit (i.e., maximum number of tubes that may be plugged) is given in Appendix 2.

ENTERGY NUCLEAR NORTHEAST - IP # 3
EDDY CURRENT CALIBRATION TUBE INDEX

CALIBRATION TUBE NO.	TUBE O.D. (IN.)	TUBE WALL THICKNESS (IN. / BWG)	TUBE MATERIAL	STANDARD TYPE	PLANT COMPONENT
001	7/8"	0.028" (22 BWG)	Titanium Prime Surface	ASME	Main Condenser Waterboxes
002	7/8"	0.028" (22 BWG)	Titanium Prime Surface	Thinning	(Same as 001)
003	7/8"	0.072" (15 BWG)	Titanium Prime Surface	ASME	(Same as 001)
004	7/8"	0.072" (15 BWG)	Titanium Prime Surface	Thinning	(Same as 001)
005	1"	0.049" (18 BWG)	Brass Prime Surface	Groove Std.	Main Exciter Air Coolers 31 & 32
005A-1	1"	0.049" (18 BWG)	Brass Prime Surface	ID Round Bottom Pits	(Same as 005)
005A-2	1"	0.049" (18 BWG)	Brass Prime Surface	ID Round Bottom Pits	(Same as 005)
005A-3	1"	0.049" (18 BWG)	Brass Prime Surface	360° ID Wall Reduction	(Same as 005)
005A-4	1"	0.049" (18 BWG)	Brass Prime Surface	1/8" Wide x 1/4" Long ID Pit	(Same as 005)
006	7/8"	0.049" (18 BWG)	Brass Prime Surface	ASME	Hydrogen Coolers (Old tubes)
007	5/8"	0.065" (16 BWG)	Brass Prime Surface	ASME	THCCW HXs 31 & 32
007A-1	5/8"	0.065" (16 BWG)	Brass Prime Surface	ID Round Bottom Pits	(Same as 007)
007A-2	5/8"	0.065" (16 BWG)	Brass Prime Surface	ID Round Bottom Pits	(Same as 007)
007A-3	5/8"	0.065" (16 BWG)	Brass Prime Surface	360° ID Wall Reduction	(Same as 007)
007A-4	5/8"	0.065" (16 BWG)	Brass Prime Surface	1/8" Wide x 1/4" Long ID Pit	(Same as 007)

ENTERGY NUCLEAR NORTHEAST - IP # 3
EDDY CURRENT CALIBRATION TUBE INDEX

CALIBRATION TUBE NO.	TUBE O.D. (IN.)	TUBE WALL THICKNESS (IN. / BWG)	TUBE MATERIAL	STANDARD TYPE	PLANT COMPONENT
*008	5/8"	0.049" (18 BWG)	Brass Prime Surface	ASME	Main Turbine Lube Oil Coolers 31 & 32; MBFP Lube Oil Coolers 31 & 32; I/A Compressors 31 & 32*; EDG Lube Oil Coolers 31, 32, 33*; Airside Seal Oil Coolers A, B, C, D; Hydrogen Side Seal Oil Cooler
008A-1	5/8"	0.049" (18 BWG)	Brass Prime Surface	ID Round Bottom Pits	(Same as 008)
008A-2	5/8"	0.049" (18 BWG)	Brass Prime Surface	ID Round Bottom Pits	(Same as 008)
008A-3	5/8"	0.049" (18 BWG)	Brass Prime Surface	360° ID Wall Reduction	(Same as 008)
008A-4	5/8"	0.049" (18 BWG)	Brass Prime Surface	1/8" Wide x 1/4" Long ID Pit	(Same as 008)
*009	3/8"	0.028" (22 BWG)	Brass Prime Surface	ASME	EDG Jacket Water Coolers 31, 32, 33*
010	5/8"	0.035" (20 BWG)	90/10 Cu-Ni Prime Surface	ASME	Isophase Bus Duct Coolers A, B, C; CCR A/C 31 & 32 Condensers (Old); Airside Seal Oil Coolers B, C, D (Old)
010B-1	5/8"	0.035" (20 BWG)	90/10 Cu-Ni Prime Surface	ID Round Bottom Pits	(Same as 010)
010B-2	5/8"	0.035" (20 BWG)	90/10 Cu-Ni Prime Surface	ID Round Bottom Pits	(Same as 010)
010B-3	5/8"	0.035" (20 BWG)	90/10 Cu-Ni Prime Surface	360° ID Wall Reduction	(Same as 010)
010B-4	5/8"	0.035" (20 BWG)	90/10 Cu-Ni Prime Surface	1/8" Wide x 1/4" Long ID Pit	(Same as 010)
*011	5/8"	0.028" (22 BWG)	AL-6X SS Prime Surface	ASME	FCUs 31,32,33,34,35*; FCU Motor Coolers 31,32,33,34,35*
012	3/4"	0.035" (20 BWG)	304 SS Prime Surface	Combination	Steam Jet Air Ejector (SJAE) Condensers 31,32,33
013	7/8"	0.035" (20 BWG)	439 SS Prime Surface	Combination	FW Heaters 34A, 34B, 34C
014	3/4"	0.035" (20 BWG)	439 SS Prime Surface	Combination	FW Heaters 33A, 33B, 33C; FW Heaters 35A, 35B, 35C
015	3/4"	0.035" (20 BWG)	439 SS Prime Surface	O.D. Flats	(Same as 014)
016	3/4"	0.065"	439 SS Low Fin	Sawcuts / Hole / Wear Scars	Gland Steam Condenser
017	3/4"	0.065"	439 SS Low Fin	Sawcuts / Hole	(Same as 016)

ENTERGY NUCLEAR NORTHEAST - IP # 3
EDDY CURRENT CALIBRATION TUBE INDEX

CALIBRATION TUBE NO.	TUBE O.D. (IN.)	TUBE WALL THICKNESS (IN. / BWG)	TUBE MATERIAL	STANDARD TYPE	PLANT COMPONENT
018	5/8"	0.049" (18 BWG)	439 SS Prime Surface	Combination	FW Heaters 36A, 36B, 36C
019	5/8"	0.049" (18 BWG)	439 SS Prime Surface	Sawcuts / Hole	(Same as 018)
020	5/8"	0.035" (20 BWG)	439 SS Prime Surface	Combination	FW Heaters 31A, 31B, 31C; FW Heaters 32A, 32B, 32C
*021	5/8"	0.049" (18 BWG)	Brass Prime Surface	Combination	CCW HXs 31 & 32 *
*022	5/8"	0.035" (20 BWG)	Finned Copper	ASME	CCRAC Condensers 31 & 32, A & B (Old)
023	5/8"	0.058" (17 BWG)	439 SS Prime Surface	ASME	Steam Generator Blow Down HX
024	5/8"	0.077" (15 BWG)	439 SS Prime Surface	Support Wear	(Same as 023)
025	7/8"	0.049" (18 BWG)	Aluminum Bronze Prime Surface	ASME	Hydrogen Coolers 31,32,33,34 (Old)
026	7/8"	0.049" (18 BWG)	Aluminum Bronze with External Fins	ID Pit	(Same as 025)
*027	3/4"	0.035" (20 BWG)	Copper - ID Enhanced & OD Finned	Holes / Sawcut / Wear Scars	CCRAC Condensers 31 & 32, A & B (New)
027A-1	3/4"	0.035" (20 BWG)	Copper - ID Enhanced & OD Finned	ID Round Bottom Pits	(Same as 027)
027A-2	3/4"	0.035" (20 BWG)	Copper - ID Enhanced & OD Finned	ID Round Bottom Pits	(Same as 027)
027A-3	3/4"	0.035" (20 BWG)	Copper - ID Enhanced & OD Finned	360° ID Wall Reduction	(Same as 027)
027A-4	3/4"	0.035" (20 BWG)	Copper - ID Enhanced & OD Finned	1/8" Wide x 1/4" Long ID Pit	(Same as 027)
028	3/4"	0.049" (Note: actual MSRs have 0.065" wall)	439 SS Full Finned	ASME	MSRs 31A, 31B, 32A, 32B, 33A, 33B

ENTERGY NUCLEAR NORTHEAST - IP # 3
EDDY CURRENT CALIBRATION TUBE INDEX

CALIBRATION TUBE NO.	TUBE O.D. (IN.)	TUBE WALL THICKNESS (IN. / BWG)	TUBE MATERIAL	STANDARD TYPE	PLANT COMPONENT
029	3/4"	0.049" (Note: actual MSRs have 0.065" wall)	439 SS Full Finned	Holes / Sawcut / Wear Scars	(Same as 028)
030A	7/8"	0.049" (18 BWG)	AL-6XN SS with External Soldered Fins	ASME	Hydrogen Coolers 31,32,33,34 (New)
030B	7/8"	0.049" (18 BWG)	AL-6XN SS with External Soldered Fins	ID Pit (Round Bottom)	(Same as 030A)
030C	7/8"	0.049" (18 BWG)	AL-6XN SS with External Soldered Fins	ID Pit (Round Bottom)	(Same as 030A)
030D	7/8"	0.049" (18 BWG)	AL-6XN SS with External Soldered Fins	360° ID Wall Reduction	(Same as 030A)
030E	7/8"	0.049" (18 BWG)	AL-6XN SS with External Soldered Fins	ID Rectangular Pits	(Same as 030A)