ATTACHMENT 12
Sheet 1 of 1

Problem Report 96.0396 RType G7.07

PROBLEM REPORT

PROBLEM REPORT CLOSURE SHEET

Use of this form is not required.

Closure Justification: Check one or more of the following and/or provide additional information as required:

✓ Evaluation and Corrective Action Complete

_____ See Evaluation Response

_____ See Corrective Action Response

_____ This issue will be addressed by PR# _____

_____ This issue will be/has been addressed by MR# _____

_____ Other (See below)

Trending _____ HPI _____ EF ✓ No Trend ACE

Closed By [signature] 7/7/98
Signature Date

PR Data Entry Completed/Captured S J Stiles 7/13/98
Signature Date

ENTERED

PR

Integrated Action Item Database Revision Form

PR96.0396.01 Extension: 3

EVALUATION

Date: 07/12/97

Responsible Manager: LOOMIS, L. PLG51 **Status:** OPEN [illegible]

Group: NUC SVCS **Significance:** 2

Department: CHEMISTY **Strategy:** **Priority:** A0

Sub Department: **Doc Type/Number:** ENTERED

Title

HIGH NITRATE LEVELS EXIST IN THE TBCCW SYSTEM. HIGH NITRATE CONCENTRATIONS HAVE BEEN ASSOCIATED WITH STRESS CORROSION CRACKING OF CARBON STEEL PIPING.

Rec'd Date:	/ /	**Due Date:**	08/01/97
Assign Date:	09/24/96	**Dead Date:**	08/30/97
Start Date:	10/01/96	**Completion Date:**	/ /

Action

CONDUCT AN EVALUATION TO DETERMINE THE CAUSE OF THE HIGH NITRATE LEVELS IN THE TBCCW SYSTEM. DETERMINE CORRECTIVE ACTIONS AND ACTIONS TO PRECLUDE RECURRENCE.

Closure Requirements

COMPLETE EVALUATION PER NOP92A1, SECTION 6.4

See attached response for closure

Notes/Basis for Change(s)

DATE EXTENSION REVIEW [11/29/96; FOUNTAIN, D.] MORE TIME NEEDED FOR EVALUATION. IN HOUSE TESTING IS INCLUSIVE AND EFFORTS ARE BEING MADE TO HAVE SAMPLES BY VENDOR LABORATORY.

[4/18/97; C. GODDARD] EXTEND DUE TO MANPOWER RESTRAINTS

[6/24/97; LANDAHL] EXTEND DUE/DEADS DUE TO MANPOWER RESTRAINTS

Recommend closure based on attached

Change(s) Approved By: [signature] Date: 11 7/14/97
Manager

Change(s) Accepted By: [signature] Date: 11 7/15/97
PR Coordinator

ENTERED

PROBLEM REPORT

PROBLEM REPORT No. PR96.0396.01

Title:HIGH NITRATE LEVELS EXIST IN THE TBCCW SYSTEM. HIGH NITRATE CONCENTRATIONS HAVE BEEN ASSOCIATED WITH STRESS CORROSION CRACKING OF CARBON STEEL PIPING.

EVALUATION RESPONSE

1. Problem Description: High nitrate levels exist in the TBCCW system which have been associated with SCC in carbon steel piping.

2. Direct Cause:

One likely cause could have been a system leak which introduces air which converts nitrite(the chemical additive) to nitrate. However, the TBCCW system is known to be a tight system with little leakage.

Another possible cause seen in the industry is the conversion of nitrite to nitrate due bacteria. This is likely considering system conditions such as temperature and flow.

3. Repeat Occurrence: _____ YES __X__ NO

4. Maintenance Rule Functional Failure: ____ YES ____ NO _X_ Unknown

5. Corrective Actions Completed (include Dates if possible)
N/A

6. Corrective Actions Required (check "N/R" if not required) ____ N/R

a) Action Required
1) Chemistry will sample for bacteria and send to vendor for analysis.(This action is captured under PR96.0396.03

Closure Requirement
Results of vendor analyses received,evaluated and documented.

Responsible Manager

L.Loomis \ Chemistry

Due Date _12_/__01_/__97_ Dead Date __12__/__30__/_97__

7. Corrective Actions Required to Preclude Recurrence (check "N/R" if not required) X_ N/R

8. Trend Data for Apparent Cause (check "N/R" for Direct Cause Analysis) ___X___N/R

9. The Significance should: _____ Be Upgraded _____ Be Downgraded __X__ Remain the Same

If applicable, the reason for the upgraded:

Completed By: Larry Moomi Date: 7/18/97
Evaluator/Mentor

Approved By: BJ Ol. ... for WJR Date: 7/16/97
Manager

PR

Integrated Action Item Database Revision Form

PR96.0398.02 Extension: 0

EVALUATION

Date: 09/27/96

ENTERED

Responsible Manager: PACE, R

Division: NESG

Department: CIV MECH

Sub Division:

Status: ~~OPEN~~ [redacted]

Significance: 2

Priority: A2

Doc Type/Number:

Title

HIGH NITRATE LEVELS EXIST IN THE TBCCW SYSTEM. HIGH NITRATE CONCENTRATIONS HAVE BEEN ASSOCIATED WITH STRESS CORROSION CRACKING OF CARBON STEEL PIPING.

Rec'd Date:	/ /	Due Date:	11/01/96
Assign Date:	09/24/96	Dead Date:	12/01/96
Start Date:	10/01/96	Completion Date:	/ /

Action

DETERMINE THE EFFECTS OF THE ELEVATED NITRATE LEVELS ON THE CARBON STEEL PIPING OF THE TBCCW SYSTEM.

Closure Requirements

MEMO DETAILING THE RESULTS THE EVALUATION AND THE REQUIRED CORRECTIVE ACTIONS. CONCURRENCE MUST BE OBTAINED FROM ACTION ITEM OWNERS.

NOTE: CHEMISTRY HAS ALSO BEEN ASSIGNED AN ACTION TO DETERMINE THE CAUSE OF THE EXCESS NITRATE AND SHOULD BE ABLE TO PROVIDE ADDITIONAL INFORMATION TO ASSIST IN YOUR EVALUATION

Notes/Basis for Change(s)

Change(s) Approved By: T. White Manager Date: 12/4/97

Change(s) Accepted By: [signature] PR Coordinator Date: 12/6/97

PROBLEM REPORT

PROBLEM REPORT No. 96.0396.05 02

1. Problem Description:

High Nitrate levels exist in the TBCCW System. High Nitrate concentrations have been associated with stress corrosion cracking of carbon steel piping.

2. Apparent/Direct Cause:

Based on a study of literature on this subject, the likely direct cause is Nitrobacter bacteria conversion of Nitrites to Nitrates. An action item should be given Chemistry to sample and analyze the RBCCW and TBCCW, including the make-up water source, for the presence of Nitrobacter bacteria.

3. Repeat Occurrence: __✓__ YES _____ NO

4. Maintenance Rule Functional Failure: ____ YES __✓__ NO ____ Unknown

5. Corrective Actions Completed (include Dates if possible)

A literature search (See Attached Letter for details and date completed) was performed to determine the most probable cause of the Nitrate build-up and its affect on carbon steel piping. Based on this research for the Nitrate concentration, system operating conditions and the duration of the present problem, the probability of developing stress corrosion cracking is low. However due to the lack of conclusive data at the appropriate operating conditions there is sufficient probability of stress corrosion cracking that an action item should be given to the MSTP Group to develop a program of sufficient duration to inspect TBCCW piping welds. Civ/ Struct./ Mech will assist the MSTP Group in the selection of inspection locations, as necessary.

6. Corrective Actions Required (check "N/R" if not required) ____ N/R

a) Action Required

Chemistry to sample and analyze the RBCCW and TBCCW, including the make-up water source, for the presence of Nitrobacter bacteria.

Closure Requirement

If Nitrobacter bacteria are found a biocide should be introduced as a part of a chemical treatment program to eliminate the bacteria and reduce the Nitrate concentration. PROVIDE MEMO DOCUMENTING DETAILS OF THIS COMPLETION

Responsible Manager Dave Fountain

Due Date 04/01/97 **Dead Date** 06/30/97

b) Action Required

MSTP Group develop a weld inspection program.

Closure Requirement

ENTERED

MSTP Group develop a weld inspection program of sufficient duration for TBCCW piping welds. PROVIDE MGMT DOCUMENTING DETAILS OF TASK COMPLETION.

Responsible Manager Kevin Burke

Due Date 04/01/97 Dead Date 06/30/97

7. Corrective Actions Required to Preclude Recurrence (check "N/R" if not required) ____ N/R

a) Action Required

Mechanical select inspection points.

Closure Requirement

Mechanical/Civil/Structural selection of 8 to 10 inspection points based on the attached letter with proposed Altran criteria.

Responsible Manager Thomas White, Jr.

Due Date 04/01/97 Dead Date 05/31/97

b) Action Required

Closure Requirement

Responsible Manager

Due Date ____/____/____ Dead Date ____/____/____

8. Trend Data for Apparent Cause (check "N/R" for Direct Cause Analysis) __✓__N/R

NOTE

If more than 2 Inappropriate Actions are defined, use Exhibit 14.

a) Inappropriate Action (IA) Description:

IA Job Title ________________ IA Group ____________________ IA Department ____________
IA Job Title ________________ IA Group ____________________ IA Department ____________

BECO __________ Contractor ___________

Work Process ____________ Key Activity ___________
Work Process ____________ Key Activity ___________

O&P Failure Mechanism ___________ HEIA Failure Mechanism ___________

Human Error Type (Circle 1): Skill Based Rule Based Knowledge Based

Procedure Number(s) _______________ Event Type ______________

b) Inappropriate Action (IA) Description:

IA Job Title ________________ IA Group ____________________ IA Department ____________
IA Job Title ________________ IA Group ____________________ IA Department ____________

BECO __________ Contractor ___________

Work Process ____________ Key Activity ___________
Work Process ____________ Key Activity ___________

O&P Failure Mechanism ___________ HEIA Failure Mechanism ___________

Human Error Type (Circle 1): Skill Based Rule Based Knowledge Based

Procedure Number(s) _______________ Event Type ______________

9. The Significance should: _____ Be Upgraded ✓ Remain the Same

If applicable, the reason for the upgraded:

Completed By: Raymond M. Pace [signature] Date: 02/03/97
Evaluator/Mentor

Approved By: Thomas White Jr. Date: 2/3/97
Manager

altran

Altran Corporation • 200 High Street • Boston, MA 02110 Tel. 617/330-1130 • Fax 617/330-1055

Mr. Raymond Pace
Boston Edison Company
Pilgrim Nuclear Power Station
600 Rocky Hill Road
Plymouth, MA 02360

December 31, 1996
96205.3

SUBJECT: Effects of Elevated Nitrate Concentrations on TBCCW and RBCCW Systems

Dear Mr. Pace:

Altran Corporation, at the request of Boston Edison Company (BECO), has performed a literature search for technical data on the effects of elevated nitrate concentrations on corrosion of carbon steels. Pilgrim Nuclear Power Station staff have measured nitrate concentrations of approximately 39 ppm in the RBCCW system and 945 ppm in the TBCCW system. A concern has been raised for possible stress corrosion cracking of the carbon steel system components as a result of the elevated nitrate concentrations.

Mechanism

The stress corrosion cracking of carbon steel discussed in the literature involves either high temperature/high concentration conditions typical in chemical processing facilities or laboratory testing under aggressive test conditions [1][1], [2]. Service temperatures referenced in the data were approximately 195°F and higher and laboratory testing typically was performed at boiling temperatures. Nitrate concentrations were 1 weight percent (10,000 ppm) and higher.

Stress corrosion cracking of carbon steel in nitrate solutions tends to be intergranular [1], [2], [3], [4]. The cracking typically is preceded by intergranular attack of the surface. One theory of the mechanism includes formation of iron oxide (Fe_3O_4) in the grain boundaries ahead of the crack by solid-state anodic reaction, anodic dissolution at the crack tip, and rapid rupture of the oxide film or oxide-metal interface [5]. Because local stresses at a weld can exceed the yield point of the steel, the stress corrosion cracking often occurs at welds [3].

Occurrences at Other Plants

Stress corrosion cracking of carbon steel by elevated nitrate concentrations is not a common corrosion mechanism in nuclear power plants. However, stress corrosion cracking of carbon steel components in cooling water systems treated with sodium nitrite have been documented at Duke Power's McGuire Station [6], [7] and Nebraska Public Power District's

[1]Numbers in [ ] indicate references listed at the end of this letter.

Cooper Station [8]. Failures of carbon steel components in a cooling water system of similar chemistry also has been documented at a power plant in Japan [9].

At McGuire Station, stress corrosion cracking was identified as the failure mechanism for a carbon steel weld heat affected zone (HAZ) in the component cooling water system. Additional inspection revealed similar through-wall cracking in the HAZ of other welds in the system, primarily in dead legs such as drain lines and supply lines to deactivated (or removed) equipment. Subsequent investigation determined that each of the crack sites was covered with a deposit. Analysis of these deposits revealed the presence of iron oxidizing bacteria (*Gallionella*) and nitrogen fixing bacteria (*Nitrobacteraceae* or *Nitrobacter*). The *Nitrobacter*, which converts nitrite to nitrate, was identified as the most likely cause of a nitrate build-up in the cooling water system to levels reportedly as high as 3500 ppm. The deposit analysis also revealed a typical nitrate concentration factor of 10:1 within the deposit.

Corrosion products found within the cracks at McGuire indicated the cracks were not new. The component cooling water system had a history of high conductivity and bacteria population problems in the mid 1980's. Additionally, the chemical treatment program was not as well controlled or implemented during that period. Attempts to correlate the crack locations with biocide treatments in the mid 1980's indicated that the biocide may not have been adequately introduced into the areas which exhibited the recent cracks. This system history and the presence of corrosion products in the cracks suggest the cracks developed in the mid to late 1980's, but were just recently discovered.

Stress corrosion cracking was detected in welds in the carbon steel RBCCW system at Cooper Station in 1978 after approximately 4 years of service [8]. During that period of service, the system was treated with sodium nitrite. The cracking was thought to be the result of nitrates concentrated in the crevices formed by backing rings at the welds. In 1980, at the recommendation of GE, the plant ceased the sodium nitrite treatment and used only DI water with no chemical treatment in the RBCCW system. Another failure occurred in 1994 and was identified as stress corrosion cracking. However, in this case, the cracking was determined to be the result of oxygen cell corrosion.

Cooper Station continues to treat the Emergency Diesel generator jacket water cooling system with sodium nitrite. There have been no stress corrosion cracking failures identified in that system.

A stress corrosion cracking failure similar to that at McGuire was reported at a Japanese power station [9]. In that failure, intergranular cracking occurred at the welds in a carbon steel circulating cooling water system. Make-up water was provided from a storage tank vented to the atmosphere and filled with demineralized river water. The system was treated with sodium nitrite as a corrosion inhibitor along with sodium carbonate, sodium borate, and benzotriazole. Most of the crack sites were covered with tubercles.

Sodium nitrite concentration was maintained at approximately 200 ppm with a conductivity limit of 1000 μS/cm at pH 9-9.5. The plant observed a decrease in sodium nitrite concentration a few days after addition of the inhibitor. A blow down of the system failed to halt the decrease. Typical water chemistry was 50-500 ppm $NaNO_2$, 100-1000 ppm $NaNO_3$, and pH 9.3.

The cause of the high nitrate concentration was determined to be the result of nitrobacteria activity. A series of tests were performed which demonstrated the conversion of nitrite to nitrate by reaction with molecular oxygen (dissolved oxygen in the water) had no appreciable effect on either the nitrite or nitrate concentrations over a test duration of 20 days. However, testing with and without (either sterilized or filtered) the bacteria showed a significant decrease in nitrite concentration and corresponding increase in nitrate concentration throughout the 10-11 days duration of the tests.

Additional testing performed by the Japanese showed the conditions within the tubercles to be much more aggressive than the bulk water chemistry [9]. Ferric nitrate formed within the tubercle is hydrolyzed to form nitric acid, driving the pH down. Depending upon the ferric nitrate concentration, pH values could be less than 3. At this pH, the nitrite ion will self-decompose to nitrate.

The conditions/mechanisms involved in the Japanese power plant cooling water system leading to the cracking were presented as:

- a 4 month period between initial system operation and the first addition of chemical treatment
- demineralized, but not sterilized or disinfected, make-up water
- development of tubercles
- bacteria conversion of nitrite to nitrate and corrosion of the steel beneath the turbercles
- lowering pH by hydrolyzation of ferric nitrate under the tubercles and in the corrosion pits
- further conversion of nitrite to nitrate in the acidic conditions
- more severe corrosion beneath the tubercles
- cracking of the carbon steel

It also was noted that the sodium carbonate component of the chemical treatment served as a carbon source for the bacteria.

Correlation to Pilgrim

There are a number of factors which affect this corrosion mechanism and prevent direct correlation of the data presented in the literature to the conditions in the Pilgrim TBCCW and RBCCW systems. Temperatures in the Pilgrim systems are normally in the range of 80-130°F [10]. Attempts to extrapolate from the higher temperature data to service temperatures similar to those at Pilgrim are not possible.

Personnel at the McGuire Station reported that the stress corrosion cracking in the component cooling water system occurred in low flow and stagnant fluid areas of the system [6], [7]. Much of the literature data fails to discuss flow conditions. Additionally, McGuire and the Japanese plant [9] identified nitrogen fixing bacteria (*Nitrobacter*) as the predominate source of the nitrate concentration through conversion of nitrite in the corrosion inhibitor. No bacteria or nitrite corrosion inhibitors are mentioned in the cracking occurrences or used in the laboratory testing discussed in the literature.

Although direct correlations may not be made between the literature and the Pilgrim systems, several statements can be made. Test data reported in the literature indicate carbon steel with a carbon content of 0.25 percent or less is more susceptible to stress corrosion cracking in nitrate solutions than steel with a higher carbon content [1], [2]. Much of carbon steel in the Pilgrim TBCCW and RBCCW systems has a specified maximum carbon limit of 0.30 weight percent. Therefore, from a material composition perspective, the system materials are susceptible.

Heat treatment of the material also is identified as a contributing factor to the stress corrosion cracking problem [1], [3], [4]. Specifically, carbon steel welds which are post weld heat treated are less susceptible to stress corrosion cracking. In the petrochemical industry, it had been common to post weld heat treat all carbon steel welds for use in service temperatures above 200°F in certain systems. After several occurrences of stress corrosion cracking of carbon steel welds in these systems, the industry practice is changing to post weld all carbon steel welds, regardless of service temperature. In nuclear power plants, the fabrication code, either ANSI B31.1 Piping or ASME Boiler and Pressure Vessel Code, does not require post weld heat treatment for most carbon steel welds which would be used in the closed loop cooling water systems. This lack of post weld heat treatment makes the Pilgrim TBCCW and RBCCW system welds more susceptible to stress corrosion cracking than heat treated welds.

Bulk water concentrations of nitrates in the Pilgrim TBCCW system reportedly reached 945 ppm, or approximately one tenth of the lowest nitrate concentration reported in the literature as being associated with stress corrosion cracking of carbon steel in nitrate solutions [8]. This concentration is approximately the same as that reported in the Japanese cooling water system [9]. McGuire Station personnel reported an estimated maximum bulk water nitrate concentration of approximately 3500 ppm [9]. However, they also reported that their analysis indicated a nitrate concentration factor of 10:1 under deposits found on each of the crack locations, as compared to the bulk fluid. Using this concentration factor and the lack of stress corrosion cracking incidents reported in the literature for nitrate concentration less than 1 weight percent, McGuire Station established an interim bulk limit of 1000 ppm nitrate concentration in the component cooling water system. Stress corrosion coupon testing is currently in progress to validate or adjust this limit. At Pilgrim, a 10:1 concentration factor can result in an approximate concentration of 9450 ppm nitrate in a deposit in the system, if such deposits exist.

The conditions reported for the Pilgrim TBCCW system indicate a potential for degradation as a result of the elevated nitrate concentration. However, additional definition of the actual conditions in the system is required to more thoroughly evaluate this potential.

Specifically, the chemical treatment program information provided by BECO indicates that no microbiocide is used. Because McGuire and the Japanese plant found nitrobacteria to be a significant contributor to the problem, the Pilgrim system should be sampled and analyzed for this bacteria. Although BECO indicates a leak required injection of air saturated makeup water to the system starting in June 1996, the conductivity to nitrite ratio indicated a sharp change in early May 1996. This suggests that a factor other than the introduction of oxygen into the system may have affected the nitrate concentration or that some other contaminant had been introduced into the system. Additionally, the testing performed by the Japanese indicates conversion of nitrites to nitrates by reaction with dissolved oxygen is minimal.

McGuire Station and the Japanese plant indicated the presence of deposits at each crack location which tended to concentrate the nitrate concentration. The crack locations at McGuire also correlated to low flow and stagnant fluid areas of the system which were suspected of not being adequately treated with a biocide. The presence of similar deposits at welds in the Pilgrim TBCCW would be indicative of a potential corrosion site.

<u>Recommendations</u>

When corrosion tests being performed by McGuire are complete, more conclusive data may be available. The following actions may be useful considerations in determining the effects of the elevated nitrate concentration in the TBCCW system.

- Sample and analyze the TBCCW water for the presence of *Nitrobacter* bacteria. Sample the RBCCW also, particularly if make-up water for both systems is provided from the same source. If nitrobacteria are found, sample and analyze the make-up water source.

- Visually inspect the exterior of the system for evidence of leakage at welds (dripping water, wetted insulation, rust staining, etc.). Investigate any leakage discovered.

- Select a sample of the welds in the system for insulation removal and more thorough inspection. Because the corrosion condition of the system is unknown and bacteria activity is a potential concern, it is not feasible to identify a sample size which could be used to assess the entire system. Data provided by inspection of sample welds will provide only an indication of the potential corrosion activity in the system. The welds selected for insulation removal should include welds from various system conditions such as:

- areas of the system with low flow or stagnant fluid conditions, such as drain lines, supply lines to standby components, and portions of the system in wet lay-up.

- welds with backing rings installed.

- welds subjected to higher stress loading (in long spans between supports, potential cold spring, cyclic or vibrating loading, etc.).

- Nondestructive examination (NDE) methods should be considered for inspection of the welds exposed by insulation removal. Because the potential cracking initiates on the wetted (interior) surface, volumetric examinations (UT and RT) would be the most useful. Surface examination by MT or PT would not detect defects which have not reached the exterior surface.

- Inspect the interior surfaces of the system which may become available for inspection during the outage due to system/component opening for other reasons (e.g., heat exchangers, pumps, valves, strainers, etc.). Inspect the interior surfaces for evidence of deposit accumulations or corrosion activity at the welds.

- Take action to reduce the nitrate concentration. In the absence of detailed information on the conditions within the system, the nitrate concentration should be lowered to a level similar to that reported in the RBCCW system. Although the nitrate concentration of 945 ppm at Pilgrim is below the 3500 ppm concentration reported at the McGuire Station, it is within the range of bulk water nitrate concentration reported for the Japanese plant which experienced cracking in the cooling water system.

As previously stated, there is little information in the literature on stress corrosion cracking of carbon steel in sodium nitrate solutions at near ambient temperatures and low nitrate concentrations. Only three occurrences of this degradation in other power plants was identified. The few references cited in this letter proved to be the most useful. Listed after the references are additional documents discussing stress corrosion cracking of carbon steels.

Please note that the information provided in this letter is an interpretation based on a limited literature search. This letter is intended to provide background information and is not intended to be used as a basis for nuclear safety related design input.

Should you have any questions, please do not hesitate to call. We will be pleased to assist your efforts to more thoroughly define the TBCCW system condition and effects of the elevated nitrate concentration and to determine appropriate mitigative actions.

Very truly yours,

ALTRAN CORPORATION

Dick Martin
Project Engineer

cc W. McBrine
O. Van Der Schijff

References:

1. J. A. Beavers, N. G. Thompson, and R. N. Parkins, *Stress-Corrosion Cracking of Low-Strength Carbon Steels in Candidate High-Level Waste Repository Environments*. Battelle's Columbus Division, BMI - 2147, NUREG / CR - 3861, February 1987.

2. H. Uhlig, K. Elaya Permumal, and M. Talerman, *Stress Corrosion Cracking If Iron in Nitrates: Effect of Carbon and Low Alloying Additions*. Corrosion, National Association of Corrosion Engineers, Vol. 30, No. 7, July 1974.

3. J. Gutzeit and J. M. Johnson, *Stress-Corrosion Cracking of Carbon Steel Welds in Amine Service*, Corrosion 96, National Association of Corrosion Engineers, Paper 206, March 1986.

4. ASM Metals Handbook, Ninth Edition, *Corrosion*, Volume 13, ASM International, September 1987.

5. James A. Donvan. *Factors Controlling Nitrate Cracking of Mild Steel*. Conference Proceedings, Environmental Degradation of Engineering Materials, Virginia Tech College of Engineering, October 10-12, 1977.

6. Telecon with Tom Foster, McGuire Station, 11/13/96.

7. Telecon with Steve Davenport, Duke Power, 11/14/96.

8 Telecon with Ken Fike, Cooper Station, 12/9/96

9. M. Izumia, N. Shimizu, and M. Yamamoto. *Stress Corrosion Cracking of Mild Steel in a Cooling Water System Due to Nitrobacteria*. 10th International Congress on Metallic Corrosion. Madras, India, November 7-11, 1987.

10. Pilgrim Nuclear Power Station Specification M300, Pipe Class HE

Additional Sources of Information

K. Zhao, *Effect of Temperature, Concentration of Medium, and Potential on Intergranular stress Corrosion Cracking of Mild Steel in NaNO//3 Solution.* 10th International Congress on Metallic Corrosion. Madras, India, November 7-11, 1987.

W. Dahl, *Investigations on the Influence of Temperature, Nitrate Concentration and Potential, as Well as Molybdenum Content and Structure on Stress Corrosion Cracking of Carbon Steels.* Werkst. Korros. May 1987. (German language)

R. Raicheff,and L. Fachikov, *Stress-Corrosion Cracking of Low-Carbon Steel in Nitrate Solutions.* Eurocorr Conference, Budapest, Hungary. GTE Rendezveny Iroda Gondozasaban. October 21-25, 1991.

S. W. Ciaraldi, *Stress-Corrosion Cracking of Carbon and Low-Alloy Steels (Yield Strengths Less than 1241 MPa).* Stress Corrosion Cracking: Materials Performance and Evaluation, ASM International, 1992, pp.41-61.

Z. Chen, G. Zhou, and J. Dong, *Stress Corrosion Cracking of Welded Joints in caustic and Nitrate Solutions.* 10th International Congress on Metallic Corrosion. Madras, India, November 7-11, 1987.

C. M. Rangel and R. N. Parkins, *Aspects of the Inhibition by Nitrite of the Stress Corrosion Cracking of Mild Steel in Nitrate Solutions.* 6th European Symposium on corrosion Inhibitors, Ferrara, Italy, September 16-20, 1985. (Russian language)

J. Zuo, G. Wang, and Y. Xu, *Investigation of Chemical and Electrochemical Changes Within Crevices and Stress Corrosion cracks in Mild Steel in Nitrate Solution.* International Congress on Metallic Corrosion. Toronto, Canada, June 3-7, 1984.

M. S. de Santa Maria, J. I. Verdeja, and J. A. Perosanz, *Failure Analysis of a Low-Carbon Steel Structure: a Stress Corrosion Problem.* 13th Annual Technical Meting, International Metallographic Society, Brighton, England, August 18-20, 1980.

J. I. Mickalonis, *Corrosion Study for Waste Tanks to High Salt Concentration Conditions.* Westinghouse Savannah River Company Report No. WSRC-TR-95-0116, March 10, 1995.

PR

Integrated Action Item Database Revision Form

PR96.0396.03 Extension: 3

CA

Date: 04/02/1998

ENTERED

Responsible Manager: FOUNTAIN, D. **Status:** ~~OPEN~~ closed

Group: NUC SVCS **Significance:** N.

Department: CHEMISTY **Strategy:** **Priority:** 90

Sub Department: **Doc Type/Number:**

Title

HIGH NITRATE LEVELS EXIST IN THE TBCCW SYSTEM. HIGH NITRATE CONCENTRATIONS HAVE BEEN ASSOCIATED WITH STRESS CORROSION CRACKING OF CARBON STEEL PIPING.

Rec'd Date:	/ /	Due Date:	03/01/1998
Assign Date:	02/06/1997	Dead Date:	04/01/1998
Start Date:	02/06/1997	Completion Date:	/ /

Action

CHEMISTRY TO SAMPLE AND ANALYZE THE RBCCW AND TBCCW, INCUDING THE MAKE-UP WATER SOURCE, FOR THE PRESENCE OF NITROBACTER BACTERIA.

Closure Requirements

IF NITROBACTER BACTERIA ARE FOUND A BIOCIDE SHOULD BE INTRODUCED AS A PART OF A CHEMICAL TREATMENT PROGRAM TO ELIMINATE THE BACTERIA AND REDUCE THE NITRATE CONCENTRATION. PROVIDE MEMO DOCUMENTING DETAILS OF TASK COMPLETION.

Notes/Basis for Change(s)

[5/28/97, FOUNTAIN, D.] EXTEND DUE AND DEAD DATES DUE TO RESTRAINTS IN PROCEDURAL REVISIONS TO ALLOW SAMPLES TO BE SENT OFFSITE FOR VENDOR ANALYSIS.

[7/14/97, FOUNTAIN, D.] MORE TIME NEEDED TO COMPLETE. REVISED ACTION PLAN (SEE RESPONSE TO PR96.0396.01)
1) CHEMISTRY WILL DEVELOP A P.O. FOR VENDOR LAB ASSISTANCE THAT WILL ANALYZE FOR THE PRESENCE OF BACTERIA KNOWN TO CAUSE THE PROBLEM SEEN IN TBCCW. 9/15/97
2) CHEMISTRY WILL SAMPLE FOR BACTERIA IN TBCCW AND SEND TO VENDOR FOR ANALYSIS. 10/15/97
3) CHEMISTRY WILL FURTHER EVALUATE THE CAUSE TO TBCCW HIGH NITRATES AFTER RESULTS OF LAB ANALYSIS ARE RECEIVED. 12/1/97

[1/7/98, FOUNTAIN, D.] PLEASE EXTEND DUE AND DEAD DATES. ADDITIONAL TIME IS NEEDED BECAUSE SAMPLING MUST COINCIDE WITH MAINTENANCE OF SLIPSTREAM FILTER. MAINTENANCE IS SCHEDULED FOR MARCH 98. IN HOUSE TESTING HAS SHOWN NO INDICATION OF BACTERIA.
EXTENDING THIS ACTION ITEM:
1) WILL NOT IMPACT NUCLEAAR, INDUSTRIAL OR RADIOLOGICAL SAFETY.
2) WILL NOT ADVERSELY AFFECT QUALITY.

[4/2/98, FOUNTAIN, D.] TESTING WAS PERFORMED IN HOUSE DUE TO THE INABILITY TO LOCATE A QUALIFIED LABORATORY CAPABLE OF PERFORMING TESTING IN THIS AREA. (SAMPLES MUST BE AT THE VENDORS LABORATORY LESS THAN 24 HOURS AFTER SAMPLING.)

THE HACH COMPANY PROVIDES TEST KITS FOR PERFORMING NITROBACTERIA TESTING ON SITE. THESE TEST KITS WERE PURCHASED AND SAMPLES WERE ANALYZED IN HOUSE FOR THE RBCCW, TBCCW AND MAKEUP WATER SYSTEMS. NO DETECTABLE NITROBACTERIA WAS IDENTIFIED.

MULTIPLE SAMPLES WERE ANALYZED ON THE TBCCW SYSTEM FROM VARIOUS LOCATIONS WHERE THE HIGHEST POTENTIAL FOR BACTERIA EXISTED. SAMPLES FROM THE SLIPSTREAM FILTER WERE INCUBATED TO INCREASE THE NUMBER OF COLONIES PRESENT IF ANY NITROBACTERIA EXISTED. THESE SAMPLES ALSO SHOWED NO SIGNS OF DETECTABLE NITROBACTERIA WHEN TESTED WITH THE HACH TEST KITS.

PR

Integrated Action Item Database Revision Form

PR96.0396.03 Extension: 3

CA

Date: 04/02/1998

ADDITIONALLY, SAMPLES WERE TAKEN FOR TOTAL BACTERIA ON THESE SYSTEMS AND ZERO COLONIES WERE DETECTED. MONTHLY SAMPLING FOR TOTAL BACTERIA IS NOW ROUTINELY PERFORMED ON ALL CLOSED COOLING WATER SYSTEMS.

SAMPLING FOR NITRATE LEVELS IN THE TBCCW SYSTEM (AND RBCCW) ARE ALSO PERFORMED MONTHLY. NO SIGNIFICANT TRENDS IN NITRATE HAVE BEEN IDENTIFIED.

THE RATIO OF THE 'SYSTEM CONDUCTIVITY' TO 'NITRITE' IS ALSO CALCULATED DURING WEEKLY ANALYSIS. THIS IS ANOTHER METHOD TO DETERMINE IF ANY ADVERSE TRENDS ARE OCCURING WITHIN A CLOSED COOLING SYSTEM. AGAIN NO SIGNIFICANT TRENDS HAVE BEEN IDENTIFIED.

DUE TO THE LACK OF TOTAL BACTERIA AND NITROBACTERIA AS DETERMINED BY GRAB SAMPLING THIS ITEM IS CLOSED. NO ADDITIONAL ACTIONS ARE REQUIRED UNLESS FUTURE ROUTINE TESTING WERE TO REVEAL ADVERSE TRENDS. A NEW PROBLEM REPORT WOULD BE GENERATED AT THAT TIME.

Change(s) Approved By: [signature] Manager Date: 4/5/98

Change(s) Accepted By: [signature] PR Coordinator Date: 7/2/98

ENTERED

PR

PR96.0396.04 Extension: 0

CA

Date: 05/20/97

Responsible Manager:	BURKE, K.	**Status:**	~~OPEN~~ [illegible]
Group:	PLANT	**Significance:**	N.
Department:	OPS	**Strategy:** **Priority:**	90
Sub Department:	OPS SUP	**Doc Type/Number:**	

Title

HIGH NITRATE LEVELS EXIST IN THE TBCCW SYSTEM. HIGH NITRATE CONCENTRATIONS HAVE BEEN ASSOCIATED WITH STRESS CORROSION CRACKING OF CARBON STEEL PIPING.

Rec'd Date:	/ /	**Due Date:**	04/01/97
Assign Date:	02/06/97	**Dead Date:**	05/30/97
Start Date:	02/06/97	**Completion Date:**	/ /

Action

MSTP GROUP DEVELOP A WELD INSPECTION PROGRAM.

Closure Requirements

MSTP GROUP DEVELOP A WELD INSPECTION PROGRAM OF SUFFICIENT DURATION FOR TBCCW PIPING WELDS. PROVIDE MEMO DOCUMENTING DETAILS OF TASK COMPLETION.

Notes/Basis for Change(s)

MSTP NODE S601262 CREATED TO TRACK WELD SELECTION AND EXAMINATION (SEE ATTACHED)

Change(s) Approved By [signature] Date: 5/20/97
Manager

Change(s) Accepted By [signature] Date: 5/22/97
PR Coordinator

[signature] 6/2/97

... DATE: 06:58:15 19 MAY 1997
SUEL NODE: S006800

MASTER SURVEILLANCE TRACKING PROGRAM
SEMI-ANNUAL REPORT/CHANGE FORM

NEW

1 Title: EXAMINATION OF TBCCW ~~SPECIFICATION FOR PIPING EROSION/CORROSION MONITORING~~ FOR STRESS CORROSION CRACKING

2 Procedure Number: ~~SPEC-N-597~~ QSC 50.80 [redacted]:

Node Number: ~~6800~~ S001282
Rep Task Number: ~~S006800~~

Task Type: ~~A Regulatory commitment~~ B INTERNAL COMMITMENT

Frequency: 46 1/MO
Schedule Basis: I
Lead Division: 18 QUALITY CONTROL
Owner: 18 QUALITY CONTROL
Notes/Work Instructions: ~~PROGRAM OF INSPECTION OF POINTS SELECTED BY NED IN PROCEDURE SPEC-N-597. THIS SHOULD BE DONE EVERY REFUELING OUTAGE~~ PERFORM A UT EXAMINATION OF 5 OF 11 COMPONENTS EACH RFO. 11 COMPONENTS ARE IN PROGRAM AND ALL MUST BE INSPECTED TWICE IN 5 RFO'S
Current Mode: ANY
Tasks to Generate: 1
Unit Mode: COLD SHUTDOWN
System:

Commitment/Requirement: ~~NUREG-2.90.1997; NRC GENERIC LETTER 89-08; NECO RESPONSE 89-457~~ PROBLEM REPORT 96-039606
Actions: A; P; T
Equipment Tested: PIPING
Related Tests
Preceding Tests: IDENTIFY INSPECTION LOCATIONS
Concurrent Tests:
Succeeding Tests:
Schedule Info: N/N
Done On: ~~09/15/97; 05/15/95; 05/12/93~~
Due On: RFO-12(S); ~~RFO-11(S); RFO-10(S)~~
Load On: RFO-12(E); ~~RFO-11(E); RFO-10(E)~~
Procedure: NO
Test Results
Test Results: N/A
Components: N/A

NO_OUTAGE_1; NO_SW; NO_OUTAGE_2; NO_OUTAGE_3; SMR

Submitter: [signature] 5/8/97
Task Coord.: [signature] 5/8/97
Source Mgr.: [signature] 5/8/97
System Engr.: _______ __/__/__
Task Coord.: [signature] 5/19/97 RCN Impact Y/N N

For non-conservative commitment/requirement changes
Technical Basis is required for changes to the MSTP Database.

0873 2842

PR

Integrated Action Item Database Revision Form

PR96.0396.05 **Extension: 0**

CA

Date: 05/13/97

ENTERED

Responsible Manager: PACE, R

Group: NESG

Department: CIV MECH

Sub Department:

Strategy: DE

Status: COMPLETED

Significance: N.

Priority: 90

Doc Type/Number:

Title

HIGH NITRATE LEVELS EXIST IN THE TBCCW SYSTEM. HIGH NITRATE CONCENTRATIONS HAVE BEEN ASSOCIATED WITH STRESS CORROSION CRACKING OF CARBON STEEL PIPING.

Rec'd Date:	/ /	**Due Date:**	04/01/97
Assign Date:	02/06/97	**Dead Date:**	05/31/97
Start Date:	02/06/97	**Completion Date:**	05/06/97

Action

MECHANICAL SEAL INSPECTION POINTS.

Closure Requirements

MECHANICAL/CIVIL/STRUCTURAL SELECTION OF 5 TO 10 INSPECTION POINTS BASED ON THE ATTACHED LETTER WITH PROPOSED ALTRAN CRITERIA

PROBLEM REPORT

PROBLEM REPORT No. PR96.0396.05

1. Problem Description:

High nitrate levels exist in the TBCCW system. High nitrate concentrations have been associated with stress corrosion cracking of carbon steel piping

2. Apparent/ Direct Cause

Based on a study of literature on this subject, the likely direct cause is Nitrobacter bacteria conversion of Nitrites to Nitrates

3. Repeat Occurrence: _ __YES __X NO

4. Maintenance Rule Functional Failure _____ YES __X_ NO Unknown

5. Corrective Actions Completed (include Dates if possible)

A past action item (PR 0396.02) was given Chemistry to sample and analyze the RBCCW and TBCCW, including the make-up water source, for the presence of Nitrobacter bacteria

Mechanical/ Civil/ Structural selection of 5 to 10 inspection points based on the Altran Letter with proposed criteria

6. Corrective Actions Required (check "N/R" if not required) _ _ N/R

a) Action Required

Visual inspection program developed for selected points. See Attached

Closure Requirement

Visual inspection program implemented. See Attached

Responsible Manager C. Gamow

PR

Integrated Action Item Database Revision Form

PR96.0396.05 **Extension: 0**

CA

Date: 05/13/97

Due Date: 06 / 30/ 97 Dead Date: 08 / 31 / 97

7. Corrective Actions Required to Preclude Recurrence (check "N/R" if not required) __4__ N/R

8. Trend Data for Apparent Cause (check "N/R" for Direct Cause Analysis) ___X___N/R

9. The Significance should _____ Be Upgraded 4 Remain the Same

If applicable, the reason for the upgrade: N/A

ENTERED

Completed By ______R. PACE______________________ Date: __4__/__8__/_97___
Evaluator/Mentor

Approved By ______T. WHITE______________________ Date: __4__/__8__/_97___
Manager

PROBLEM STATEMENT

As discussed in PR 96.0396.02 [3] it has been determined that elevated nitrate concentrations can result in intergranular stress corrosion cracking (IGSCC) of carbon steel (CS) piping. Because Pilgrim Nuclear Power Station (PNPS) has had a short duration of marginally unacceptable nitrate concentrations, PR 96.0396.05 requests that NESG, Mechanical/ Civil/ Structural select 5 to 10 inspection locations on the affected Turbine Building Closed Cooling Water (TBCCW) system [4].

SUMMARY

Eleven inspection locations have been selected for the inservice inspection (ISI) of the TBCCW piping for IGSCC. It is recommended that an inspection program be implemented that is 10 years in duration with 2 year inspection intervals. The duration of the program is selected to cover the incubation period necessary for the formation of IGSCC. Five inspection locations should be selected for each inspection interval and results reported to NESG (Mechanical/ Civil/ Structural). All locations should be visually inspected at a minimum of two inspection intervals over the program duration.

If problems are discovered during later inspections the scope would be expanded by the addition of several new locations for inspection and the use of volumetric inspection techniques. In this case, criteria for scope expansion will be developed based on the inspection results and water chemistry history. Therefore nitrate concentration history is an important input to the program. Chemistry was given an action item [3] to develop a program and document this information to NESG. If no IGSCC is found over the recommended program duration and low nitrate levels (<500 PPM) are maintained the inspection program can be discontinued.

A closed cooling water/ plant heating corrosion monitoring system will be installed in the near future. If a corrosion sample for the TBCCW system containing a carbon steel weld (P1) can be incorporated into the program the piping inspections may be eliminated. The monitoring of the corrosion sample is a more accurate predictor of the system condition.

ASSUMPTIONS

As stated in the Altran Corporation letter attached to the problem report, IGSCC is not common to CS piping. The interaction of the contributing factors: temperature, stress and water chemistry have not been adequately addressed in the literature and test data to date. This lack of information makes it difficult to determine the degree of susceptibility of the TBCCW piping to IGSCC at Pilgrim, although susceptibility is believed to be low based on present knowledge of the interaction parameters. The conservative assumption that it is necessary to monitor the TBCCW for IGSCC, requires development of a program. Therefore, potentially susceptible locations are identified for sampling, based on the best information currently available, to assess the adequacy of the entire system. At a later date, as further industry information becomes available and based on the inspection data, the program duration and inspection interval may be reconsidered by NESG, Mechanical/ Civil/ Structural.

In addition to the work performed by Altran, the problem and proposed inspection program were discussed (04/24/97) with Messrs. Ken Willens and Eric Bemiller of Yankee and George Licina of Structural Integrity Associates (SIA) to obtain their industry experience with IGSCC of CS piping. In a low stress system such as TBCCW the potential for cracking is greatest in the heat affected zone (HAZ) of the circumferential girth welds primarily due to the residual weld stresses. That is, since stress is an important initiation parameter. Cracking generally propagates normal to the weld (pipe longitudinal direction) and arrests once the crack propagates beyond the HAZ due to reduced stress levels.

INPUT DATA

The PR 96.0396.05 provided (Altran) inspection criteria for determining susceptibility to stress corrosion cracking that are based on:

1. Locations of low flow and/ or stagnant fluid areas (e.g., drain lines, etc.).
2. High stress weld locations, especially those which have not been post weld heat treated (PWHT).

METHOD OF EVALUATION

Inspection locations are to be selected based on the criteria listed above (see Input Data) which include low flow and high stress weld locations. Generally, operational stresses in the TBCCW piping systems are low. Therefore, more locations are selected in potential low/ stagnant flow locations (including adjacent weld HAZ) than at high operational stress locations.

A review of BECo Welding Specification M305 [2] indicates that none of the TBCCW piping welds have been PWHT. Therefore, none are eliminated from the sample population. The selection of points based on the criteria is biased to the portion of the system that is designated Pressure Boundary Only (PBO). That is, those parts of the TBCCW that are in the RBCCW pump compartments but not required for safety-related operation [1]. Large bore TBCCW system piping in these compartments designated as PBO, is stress analyzed [5] and detailed stress information is available for reference.

POINT SELECTION

The following locations have been selected for inclusion in the TBCCW IGSCC program. The selections were walked down for inspection accessibility to each of the locations. Notes are provided describing potential access problems. Some of the locations will require access using scaffolding or ladders. Five of the locations should be selected and inspected at each inspection interval. All locations should be placed in the program and inspected at a minimum of two inspection intervals over the program duration.

1. TBCCW Pumps (P-110 A & B) Suctions [6a], HX "A" loop discharge piping (16"-HE-30, El. 12'-4½") to the TBCCW pump suction header, located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect elbow downstream of valve 30-HO-670 and run of piping to anchor H-30-1-203R. Include adjacent elbow butt weld and the accessible piping in the heat affected zone formed by the anchor stanchion welds. Point selection criteria - stress.

2. TBCCW Pumps (P-110 A & B) Suctions [6a], makeup line from the condensate storage tank T-104 to TBCCW pump suction header (22"-HB-30, El. 12'-4½"), located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect a 12" length of the horizontal piping (3"-HE-30, El. 17'-8½") immediately upstream of the 900 elbow and vertical run to the branch connection at the suction header. Include piping in the heat affected zone formed by the elbow socket weld. Areas obstructed by the support brace or duct work need not be inspected. Point selection criteria - flow

3. TBCCW Pumps (P-110 A & B) Suctions [6a], heater bypass piping (16"-HE-30, El. 12'-4½") from HX "A" loop discharge piping, located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect the horizontal run of piping from the branch connection at the pump suction header (16"-HE-30, El. 12'-4½) upstream to the first (900) elbow. Include adjacent piping in the heat affected zone formed by the branch connection and elbow butt welds. Point selection criteria - flow

4. TBCCW System (from 531 to HX-E-122 A & B Inlet) [6b], heater bypass piping (16"-HE-30, El. 4'-6") to HX inlet header (20"-HE-30, El. 12'-4½"), located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect elbow between valves 30-HO-685 and TV-4161. Include elbow butt welds. Point selection criteria - flow

5. TBCCW System (from 531 to HX-E-122 A & B Inlet) [6b], return piping (4"-HE-30, El. 13'-8½") to HX inlet header (20"-HE-30, El. 12'-4½"), located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect a 12" length of the horizontal piping run immediately upstream of the 450 elbow that branches into the TBCCW HX supply header. Include the adjacent elbow butt weld. It may be somewhat difficult to gain access to this area due to an overhead lighting fixture. Point selection criteria - stress

6. TBCCW System P-110 A Discharge [6c], pump discharge piping (14"-HE-30, El. 8'-9"), located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect the elbow downstream of valve 30-HO-683. Include the elbow butt welds. Point selection criteria - flow

7. TBCCW System P-110 B Discharge [6d], pump discharge piping (14"-HE-30, El. 8'-9"), located in the "B" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect the elbow downstream of valve 30-HO-682. Include the elbow butt welds. Point selection criteria - flow

8. TBCCW Discharge to Air Condition System [6e], branch piping (4"-HE-30, El. 13'-8½") from the pump discharge header (20"-HE-30, El. 12'-8½"), located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect a 12" length of the horizontal piping and first 900 elbow upstream of the branch connection to the pump discharge header. Include the elbow butt welds. Point selection criteria - stress

9. TBCCW Discharge to Air Condition System [6e], branch piping (4"-HE-30, El. 12'-8½") from the pump discharge header (20"-HE-30, El. 12'-8½"), located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect a 12" length of 450 piping at the branch connection to the pump discharge header. This point will be extremely difficult to inspect due to congestion from surrounding piping and conduit. However, it is the system

high stress location and an important data point. Include the adjacent elbow butt welds and piping in the heat affected zone formed by the branch connection welds. Point selection criteria - stress.

10. Chemical Addition Tank T-211 C Outlet Process line [6f], branch piping (1"-HE-30, El. 14'-1") from the TBCCW pump suction piping (16"-HE-30, El. 12'-4½"), located in the "B" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect the 5-D bend branch piping component downstream of valve 30-HO-672. It is not necessary to inspect the underside of the pipe in the area obstructed by the Unistrut support brace. Point selection criteria - flow.

11. Chemical Addition Tank T-211 C Inlet Process line [6g], branch piping (1"-HE-30, El. 15'-10") from the TBCCW pump discharge piping (20"-HE-30, El. 12'-6½"), located in the Aux. Bay condensate transfer and plant heat pump compartment (Floor El. 3'-0"). Inspect the 12" length of horizontal piping, upstream from the branch connection to the pump discharge piping and valve 30-HO-686, immediately beyond the first 900 elbow. Include piping in the heat affected zone formed by the elbow socket weld. Point selection criteria - flow.

INSPECTION CRITERIA

A leak-before-break approach is advocated for this PBO system, based on a study performed using Code Case N-463-1 to determine critical flaw sizes in CS piping. The results are provided below for the bounding pipe sizes of concern. From inspection of the table it is evident that a through-wall crack will be discovered long before it reaches critical flaw size. In fact, based on the above discussion (see Assumptions) the cracks will arrest prior to reaching critical flaw size. Therefore should a problem arise it would be discovered as minor water leakage during the current schedule of Aux. Bay operator tours. The drains in the Aux. Bay are equipped to handle leakage far in excess of that anticipated from a through wall IGSCC crack. The current levels of operator tours and training are sufficient. While this level of inspection is adequate it will be augmented by a visual inspection program, specific to the locations described above.

NPS	Critical Flaw Size (inches)	
(inches)	Circumferential	Axial
3	3	42
20	16	41

The purpose of the augmented VT-1 inspections is to identify any reportable indications that suggest the presence of IGSCC in the TBCCW carbon steel piping and associated welds to NESG, Mechanical/ Civil/ Structural. This piping shall be inspected using VT-1 visual examination methods, conforming to ASME XI, 1989 Edition, with crack-like indications causing rejection or further evaluation by a BECo Level III examiner. Any detectable crack or linear indications shall be reported by a Non-Conformance Report.

REFERENCES

1. PNPS Q-List
2. PNPS Welding Requirements of Field Erected Piping, Specification M305
3. PR 96.0396.02
4. P & ID M216
5. Piping Analysis Index, M561
6. PNPS Stress Isometric Numbers (See Attachment)
   a) 6498-629
   b) 6498-630
   c) 6498-631-1
   d) 6498-631-2
   e) M1004 Sht. 5
   f) M1004 Sht. 6
7. ASME Nuclear Code Case N-463-1

ATTACHMENT —

PNPS Stress Isometric Numbers

6498-629

6498-630

6498-631-1

6498-631-2

M1004 Sht. 5

M1004 Sht. 6

PR

Integrated Action Item Database Revision Form

PR96.0396.05 Extension: 0

CA

Date: 05/13/97

Notes/Basis for Change(s)

Change(s) Approved By: ~~See attached~~ Date: / /
Manager

Change(s) Accepted By: SHATAS, A. A. Shatas Date: 05/13/97
PR Coordinator

ENTERED

PROBLEM REPORT

PROBLEM REPORT No. PR96.0396.05

EVALUATION RESPONSE

1. Problem Description:

High nitrate levels exist in the TBCCW system. High nitrate concentrations have been associated with stress corrosion cracking of carbon steel piping.

2. Apparent/ Direct Cause:

Based on a study of literature on this subject, the likely direct cause is Nitrobacter bacteria conversion of Nitrites to Nitrates.

3. Repeat Occurrence: ____YES __✓ NO

4. Maintenance Rule Functional Failure: ____ YES __✓ NO ____ Unknown

5. Corrective Actions Completed (include Dates if possible)

A past action item (PR.0396.02) was given Chemistry to sample and analyze the RBCCW and TBCCW, including the make-up water source, for the presence of Nitrobacter bacteria.

Mechanical/ Civil/ Structural selection of 5 to 10 inspection points based on the Altran Letter with proposed criteria.

6. Corrective Actions Required (check "N/R" if not required) ____ N/R

a) Action Required

Visual inspection program developed for selected points. See Attached.

Closure Requirement

Visual inspection program implemented. See Attached.

Responsible Manager C. Garrow

Due Date: 06 / 30/ 97 Dead Date: 08 / 31 / 97

b) Action Required

Closure Requirement

Responsible Manager

Due Date ___/___/___ Dead Date ___/___/___

7. **Corrective Actions Required to Preclude Recurrence** (check "N/R" if not required) __✓__ N/R

a) Action Required

Closure Requirement

Responsible Manager

Due Date ___/___/___ Dead Date ___/___/___

b) Action Required

Closure Requirement

Responsible Manager

Due Date ___/___/___ Dead Date ___/___/___

8. **Trend Data for Apparent Cause** (check "N/R" for Direct Cause Analysis) ______N/R

NOTE

If more than 2 Inappropriate Actions are defined, use Exhibit 14.

a) Inappropriate Action (IA) Description:

IA Job Title ________________ IA Group ____________________ IA Department ____________
IA Job Title ________________ IA Group ____________________ IA Department ____________

BECO __________ Contractor ___________

Work Process _____________ Key Activity __________
Work Process _____________ Key Activity __________

O&P Failure Mechanism ___________ HEIA Failure Mechanism ___________

Human Error Type (Circle 1): Skill Based Rule Based Knowledge Based

Procedure Number(s) ______________ Event Type ______________
b) Inappropriate Action (IA) Description:

IA Job Title ______________ IA Group ______________ IA Department ______________
IA Job Title ______________ IA Group ______________ IA Department ______________

BECO __________ Contractor __________

Work Process ______________ Key Activity __________
Work Process ______________ Key Activity __________

O&P Failure Mechanism __________ HEIA Failure Mechanism __________

Human Error Type (Circle 1): Skill Based Rule Based Knowledge Based

Procedure Number(s) ______________ Event Type ______________

9. The Significance should: _____ Be Upgraded __✓__ Remain the Same

If applicable, the reason for the upgraded:

Completed By: [signature] Date: 05/06/97
Evaluator/Mentor

Approved By: Thomas White Jr. Date: 5/7/97
Manager

Selection of TBCCW Piping Inspection Locations For Detection of Intergranular Stress Corrosion Cracking

PROBLEM STATEMENT

As discussed in PR 96.0396.02 [3] it has been determined that elevated nitrate concentrations can result in intergranular stress corrosion cracking (IGSCC) of carbon steel (CS) piping. Because Pilgrim Nuclear Power Station (PNPS) has had a short duration of marginally unacceptable nitrate concentrations, PR 96.0396.05 requests that NESG, Mechanical/ Civil/ Structural select 5 to 10 inspection locations on the affected Turbine Building Closed Cooling Water (TBCCW) system [4].

SUMMARY

Eleven inspection locations have been selected for the inservice inspection (ISI) of the TBCCW piping for IGSCC. It is recommended that an inspection program be implemented that is 10 years in duration with 2 year inspection intervals. The duration of the program is selected to cover the incubation period necessary for the formation of IGSCC. Five inspection locations should be selected for each inspection interval and results reported to NESG (Mechanical/ Civil/ Structural). All locations should be visually inspected at a minimum of two inspection intervals over the program duration.

If problems are discovered during later inspections the scope would be expanded by the addition of several new locations for inspection and the use of volumetric inspection techniques. In this case, criteria for scope expansion will be developed based on the inspection results and water chemistry history. Therefore nitrate concentration history is an important input to the program. Chemistry was given an action item [3] to develop a program and document this information to NESG. If no IGSCC is found over the recommended program duration and low nitrate levels (<500 PPM) are maintained the inspection program can be discontinued.

A closed cooling water/ plant heating corrosion monitoring system will be installed in the near future. If a corrosion sample for the TBCCW system containing a carbon steel weld (P1) can be incorporated into the program the piping inspections may be eliminated. The monitoring of the corrosion sample is a more accurate predictor of the system condition.

ASSUMPTIONS

As stated in the Altran Corporation letter attached to the problem report, IGSCC is not common to CS piping. The interaction of the contributing factors: temperature, stress and water chemistry have not been adequately addressed in the literature and test data to date. This lack of information makes it difficult to determine the degree of susceptibility of the TBCCW piping to IGSCC at Pilgrim, although susceptibility is believed to be low based on present knowledge of the interaction parameters. The conservative assumption that it is necessary to monitor the TBCCW for IGSCC, requires development of a program. Therefore, potentially susceptible locations are identified for sampling, based on the best information currently available, to assess the adequacy of the entire system. At a later date, as further industry information becomes available and based on the inspection data, the program duration and inspection interval may be reconsidered by NESG, Mechanical/ Civil/ Structural.

In addition to the work performed by Altran, the problem and proposed inspection program were discussed (04/24/97) with Messrs. Ken Willens and Eric Bemiller of Yankee and George Lucina of Structural Integrity Associates (SIA) to obtain their industry experience with IGSCC of CS piping. In a low stress system such as TBCCW the potential for cracking is greatest in the heat affected zone (HAZ) of the circumferential girth welds primarily due to the residual weld stresses. That is, since stress is an important initiation parameter. Cracking generally propagates normal to the weld (pipe longitudinal direction) and arrests once the crack propagates beyond the HAZ due to reduced stress levels.

INPUT DATA

The PR 96.0396.05 provided (Altran) inspection criteria for determining susceptibility to stress corrosion cracking that are based on:

1. Locations of low flow and/ or stagnant fluid areas (e.g., drain lines, etc.).
2. High stress weld locations, especially those which have not been post weld heat treated (PWHT).

METHOD OF EVALUATION

Inspection locations are to be selected based on the criteria listed above (see Input Data) which include low flow and high stress weld locations. Generally, operational stresses in the TBCCW piping systems are low. Therefore, more locations are selected in potential low/ stagnant flow locations (including adjacent weld HAZ) than at high operational stress locations.

A review of BECo Welding Specification M305 [2] indicates that none of the TBCCW piping welds have been PWHT. Therefore, none are eliminated from the sample population. The selection of points based on the criteria is biased to the portion of the system that is designated Pressure Boundary Only (PBO). That is, those parts of the TBCCW that are in the RBCCW pump compartments but not required for safety-related operation [1]. Large bore TBCCW system piping in these compartments designated as PBO, is stress analyzed [5] and detailed stress information is available for reference.

POINT SELECTION

The following locations have been selected for inclusion in the TBCCW IGSCC program. The selections were walked down for inspection accessibility to each of the locations. Notes are provided describing potential access problems. Some of the locations will require access using scaffolding or ladders. Five of the locations should be selected and inspected at each inspection interval. All locations should be placed in the program and inspected at a minimum of two inspection intervals over the program duration.

1. TBCCW Pumps (P-110 A & B) Suctions (6a), HX "A" loop discharge piping (16"-HE-30, El. 12'-4½") to the TBCCW pump suction header, located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect elbow downstream of valve 30-HO-670 and run of piping to anchor H-30-1-20SR. Include adjacent elbow butt weld and the accessible piping in the heat affected zone formed by the anchor stanchion welds. Point selection criteria - stress.

2. TBCCW Pumps (P-110 A & B) Suctions (6a), makeup line from the condensate storage tank T-104 to TBCCW pump suction header (22"-HB-30, El. 12'-4½"), located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect a 12" length of the horizontal piping (3"-HE-30, El. 17'-5¾") immediately upstream of the 90° elbow and vertical run to the branch connection at the suction header. Include piping in the heat affected zone formed by the elbow socket weld. Areas obstructed by the support brace or duct work need not be inspected. Point selection criteria - flow.

R. Pace

3. TBCCW Pumps (P-110 A & B) Suctions (6a), heater bypass piping (16"-HE-30, El. 12'-4 ½") from HX "A" loop discharge piping, located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect the horizontal run of piping from the branch connection at the pump suction header (16"-HE-30, El. 12'-4 ½) upstream to the first (90°) elbow. Include adjacent piping in the heat affected zone formed by the branch connection and elbow butt welds. Point selection criteria - flow.

4. TBCCW System (from 531 to HX-E-122 A & B Inlet) (6b), heater bypass piping (16"-HE-30, El. 4'-6") to HX inlet header (20"-HE-30, El. 12'-4 ½"), located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect elbow between valves 30-HO-685 and TV-4161. Include elbow butt welds. Point selection criteria - flow.

5. TBCCW System (from 531 to HX-E-122 A & B Inlet) (6b), return piping (4"-HE-30, El. 13'-8 ¾") to HX inlet header (20"-HE-30, El. 12'-4 ½"), located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect a 12" length of the horizontal piping run *immediately upstream of the 45°* elbow that branches into the TBCCW HX supply header. Include the adjacent elbow butt weld. It may be somewhat difficult to gain access to this area due to an overhead lighting fixture. Point selection criteria - stress.

6. TBCCW System P-110 A Discharge (6c), pump discharge piping (14"-HE-30, El. 8'-9"), located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect the elbow downstream of valve 30-HO-683. Include the elbow butt welds. Point selection criteria - flow.

7. TBCCW System P-110 B Discharge (6d), pump discharge piping (14"-HE-30, El. 8'-9"), located in the "B" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect the elbow downstream of valve 30-HO-682. Include the elbow butt welds. Point selection criteria - flow.

8. TBCCW Discharge to Air Condition System (6e), branch piping (4"-HE-30, El. 13'-8 ¾") from the pump discharge header (20"-HE-30, El. 12'-6 ½"), located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect a 12" length of the horizontal piping and first 90° elbow upstream of the branch connection to the pump discharge header. Include the elbow butt welds. Point selection criteria - stress.

9. TBCCW Discharge to Air Condition System (6e), branch piping (4"-HE-30, El. 12'-6 ½") from the pump discharge header (20"-HE-30, El. 12'-6 ½"), located in the "A" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect a 12" length of 45° piping at the branch connection to the pump discharge header. This point will be extremely difficult to inspect due to congestion from surrounding piping and conduit. However, it is the system high stress location and an important data point. Include the adjacent elbow butt welds and piping in the heat affected zone formed by the branch connection welds. Point selection criteria - stress.

10. Chemical Addition Tank T-211 C Outlet Process line (6f), branch piping (1"-HE-30, El. 14'-1") from the TBCCW pump suction piping (16"-HE-30, El. 12'-4 ½"), located in the "B" loop compartment of the Aux. Bay (Floor El. 3'-0"). Inspect the 5-D bend branch

piping component downstream of valve 30-HO-872. It is not necessary to inspect the underside of the pipe in the area obstructed by the Unistrut support brace. Point selection criteria - flow.

11. Chemical Addition Tank T-211 C Inlet Process line (6g), branch piping (1"-HE-30, El. 15'-10") from the TBCCW pump discharge piping (20"-HE-30, El. 12'-6½"), located in the Aux. Bay condensate transfer and plant heat pump compartment (Floor El. 3'-0"). Inspect the 12" length of horizontal piping, upstream from the branch connection to the pump discharge piping and valve 30-HO-686, immediately beyond the first 90° elbow. Include piping in the heat affected zone formed by the elbow socket weld. Point selection criteria - flow.

INSPECTION CRITERIA

A leak-before-break approach is advocated for this PBO system, based on a study performed using Code Case N-463-1 to determine critical flaw sizes in CS piping. The results are provided below for the bounding pipe sizes of concern. From inspection of the table it is evident that a through-wall crack will be discovered long before it reaches critical flaw size. In fact, based on the above discussion (see Assumptions) the cracks will arrest prior to reaching critical flaw size. Therefore should a problem arise it would be discovered as minor water leakage during the current schedule of Aux. Bay operator tours. The drains in the Aux. Bay are equipped to handle leakage far in excess of that anticipated from a through wall IGSCC crack. The current levels of operator tours and training are sufficient. While this level of inspection is adequate it will be augmented by a visual inspection program, specific to the locations described above.

NPS (inches)	Critical Flaw Size (inches)	
	Circumferential	Axial
3	3	42
20	16	41

The purpose of the augmented VT-1 inspections is to identify any reportable indications that suggest the presence of IGSCC in the TBCCW carbon steel piping and associated welds to NESG, Mechanical/ Civil/ Structural. This piping shall be inspected using VT-1 visual examination methods, conforming to ASME XI, 1989 Edition, with crack-like indications causing rejection or further evaluation by a BECo Level III examiner. Any detectable crack or linear indications shall be reported by a Non-Conformance Report.

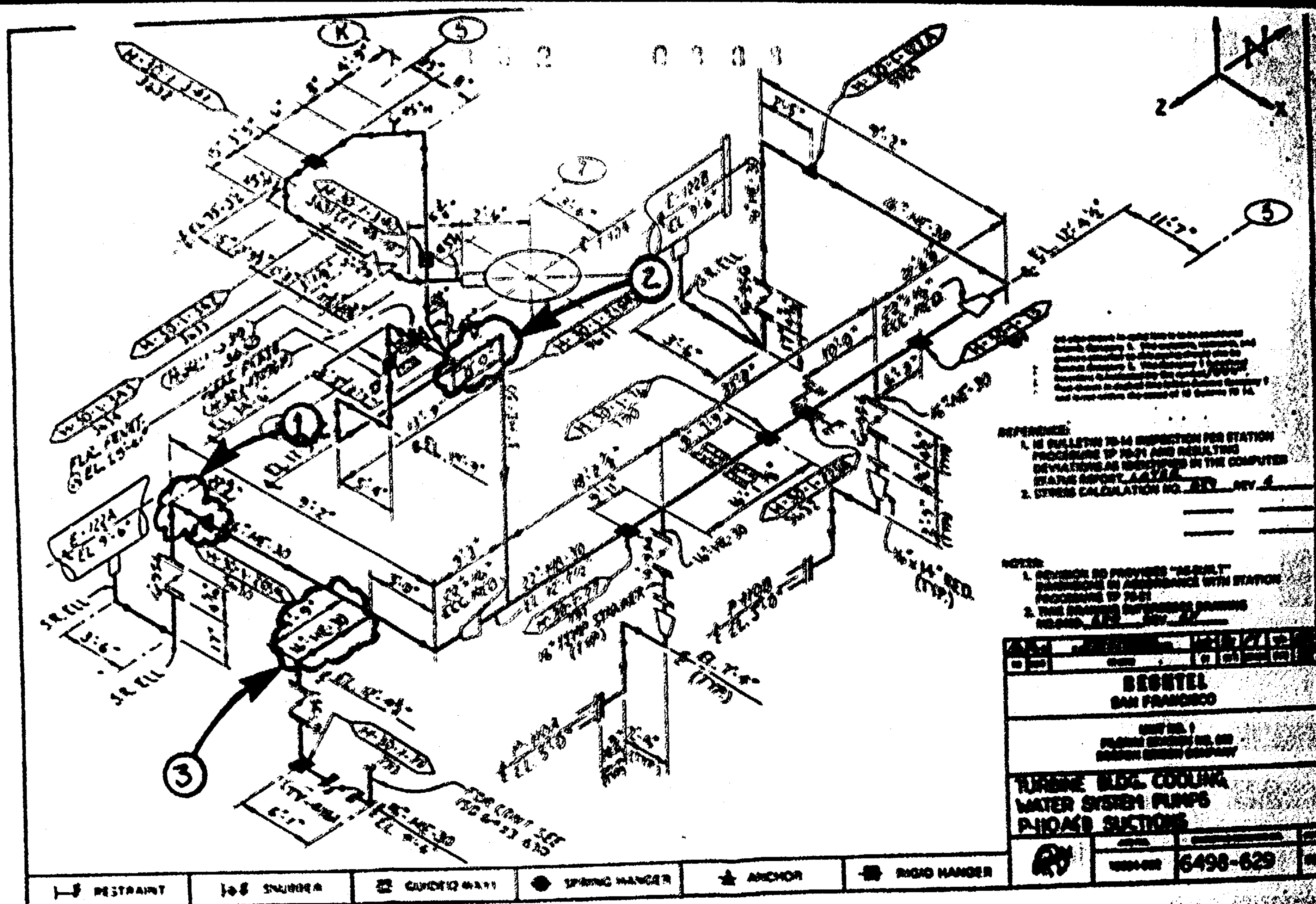
Selection of TBCCW Piping Inspection Locations For Detection of Intergranular Stress Corrosion Cracking

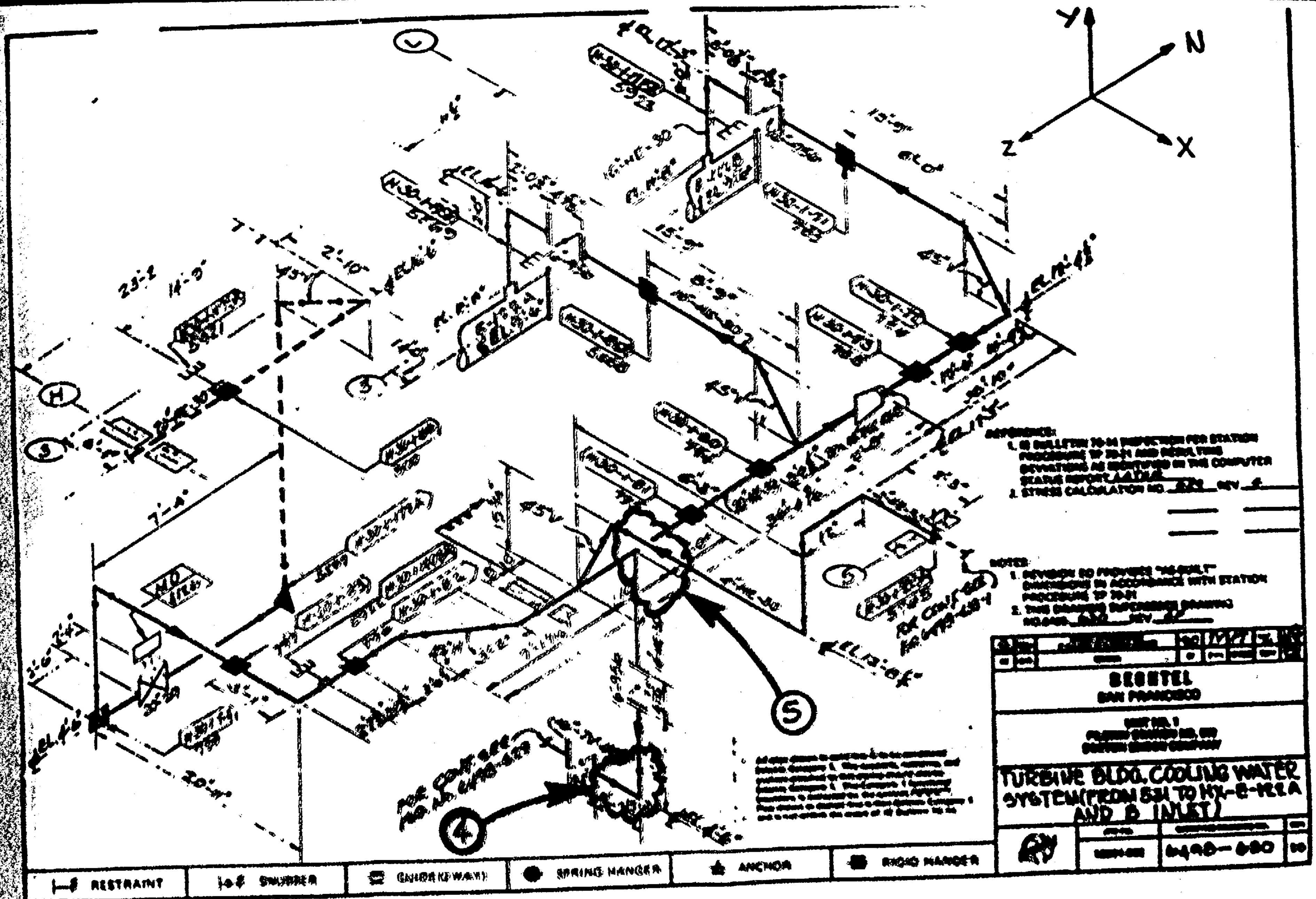
REFERENCES

1. PNPS Q-List
2. PNPS Welding Requirements of Field Erected Piping, Specification M305.
3. PR 96.0396.02
4. P & ID M216
5. Piping Analysis Index, M581
6. PNPS Stress Isometric Numbers (See Attachment):
   - a) 6498-629
   - b) 6498-630
   - c) 6498-631-1
   - d) 6498-631-2
   - e) M1004 Sht. 5
   - f) M1004 Sht. 6
7. ASME Nuclear Code Case N-463-1

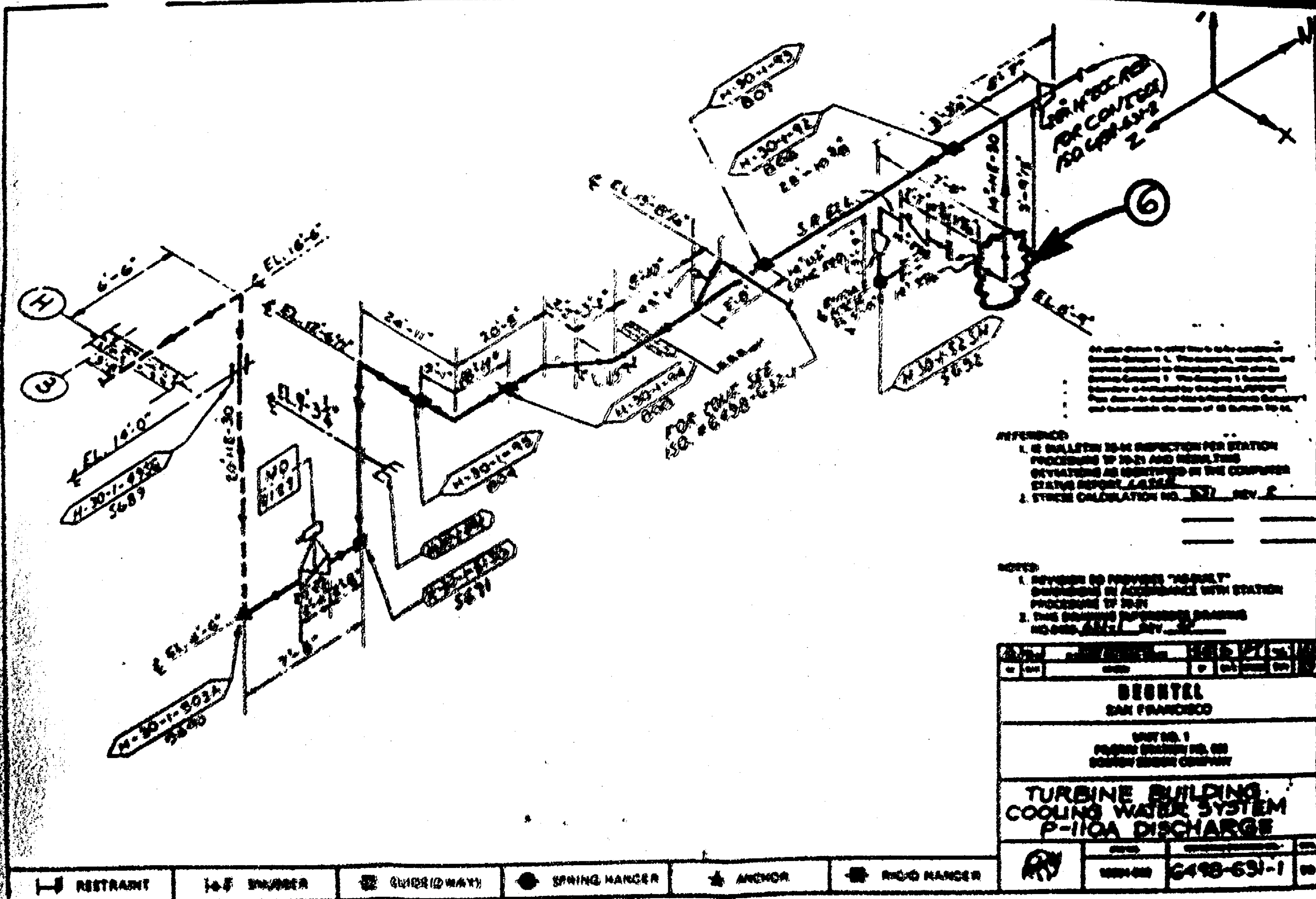
Selection of TBCCW
Piping Inspection Locations
For Detection of
Intergranular Stress Corrosion Cracking

ATTACHMENT —
PNPS Stress Isometric Numbers:
6498-629
6498-630
6498-631-1
6498-631-2
M1004 Sht. 5
M1004 Sht. 6


REFERENCES:
1. IE BULLETIN 79-14 INSPECTION PER STATION
2. STRESS CALCULATION NO.
NOTES:
BECHTEL
SAN FRANCISCO
TURBINE BLDG. COOLING WATER SYSTEM PUMPS P-10A&B SUCTIONS
6498-629
RESTRAINT
SNUBBER
SPRING HANGER
ANCHOR
RIGID HANGER

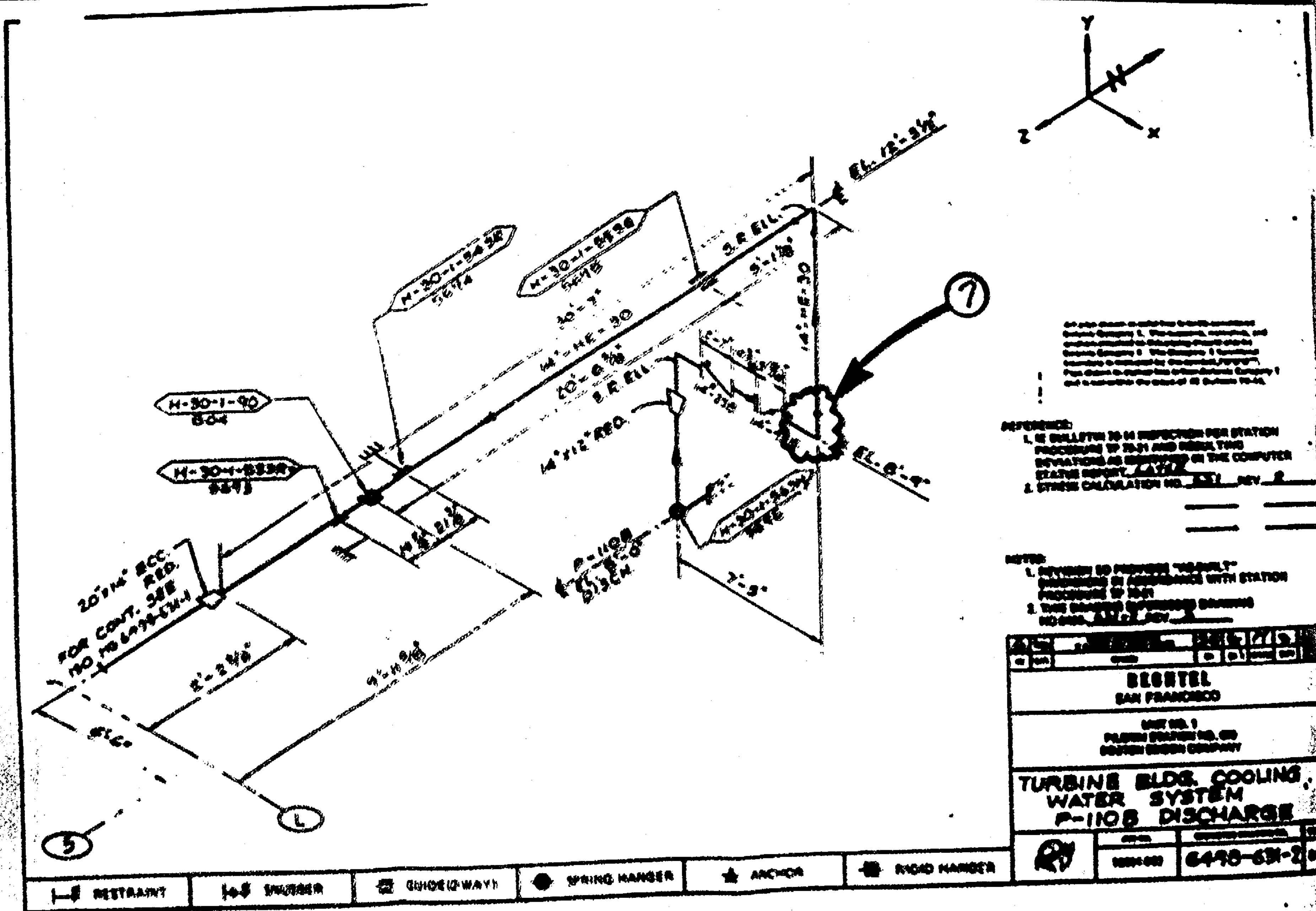


Y
N
Z
X
REFERENCE:
NOTES:
BECHTEL
SAN FRANCISCO
TURBINE BLDG. COOLING WATER SYSTEM (FROM 531 TO HX-E-122A AND B INLET)
RESTRAINT
SNUBBER
GUIDE (KEYWAY)
SPRING HANGER
ANCHOR
RIGID HANGER
5
4

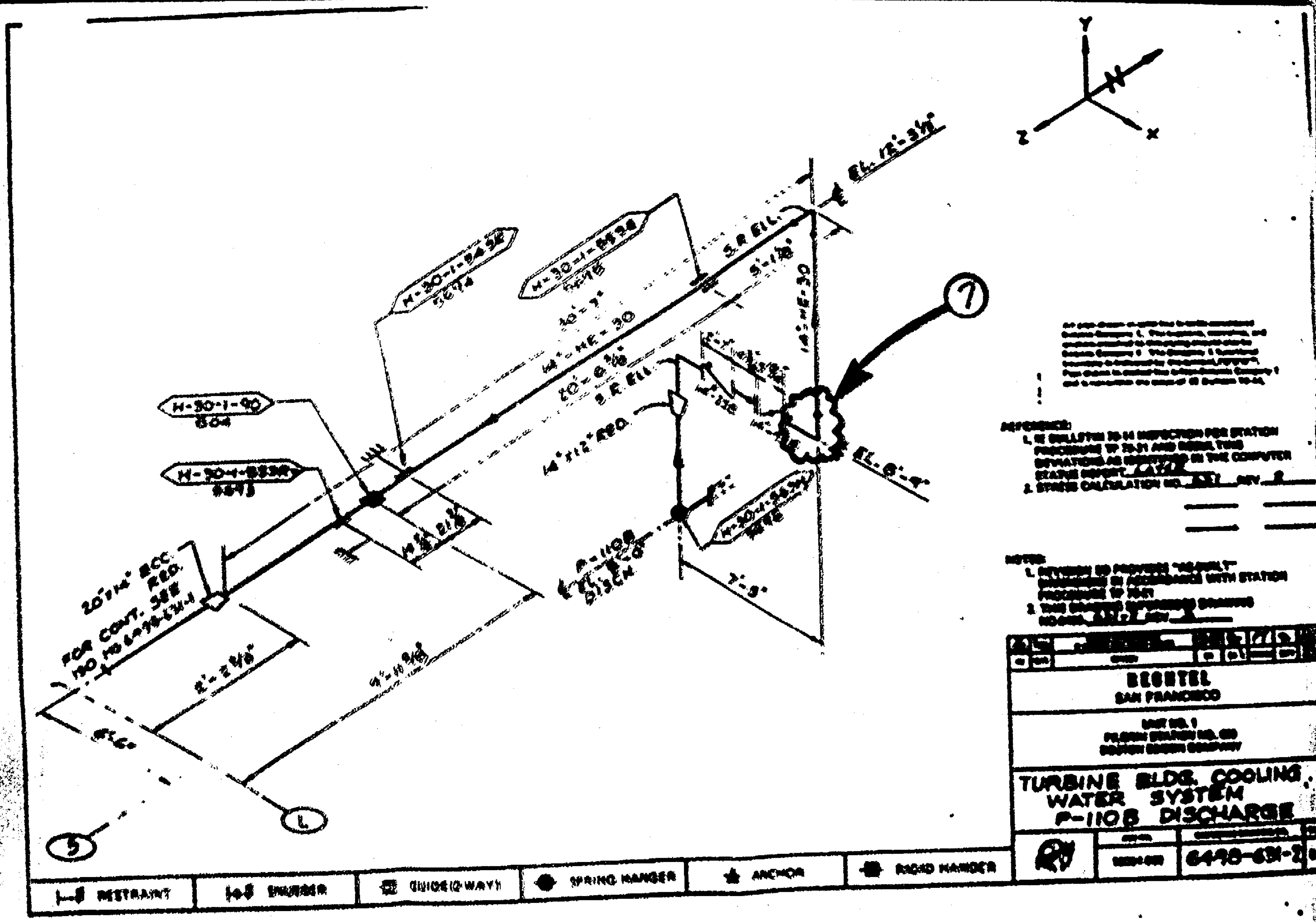


FOR CONT'D ISO 6498-631-2
FOR CONT'D SEE ISO. #6498-632-1
EL. 16'-6"
EL. 14'-0"
EL. 12'-6 1/2"
EL. 9'-3 1/4"
EL. 4'-6"
EL. 6'-5"
H-30-1-S03A
H-30-1-93
H-30-1-94
H-30-1-92
BECHTEL
SAN FRANCISCO
TURBINE BUILDING
COOLING WATER SYSTEM
P-110A DISCHARGE
6498-631-1
RESTRAINT
SNUBBER
GUIDE(2 WAY)
SPRING HANGER
ANCHOR
RIGID HANGER

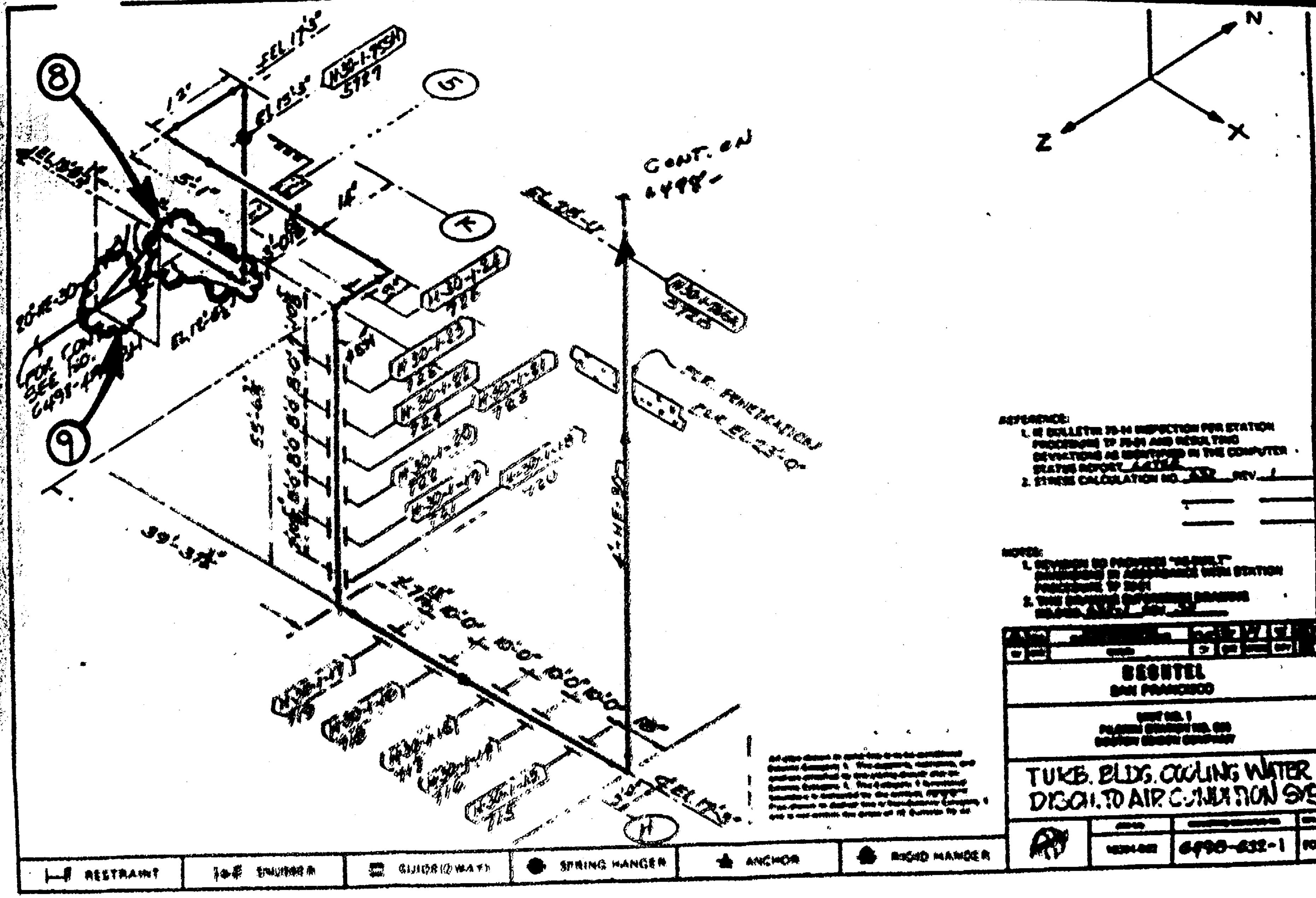
10



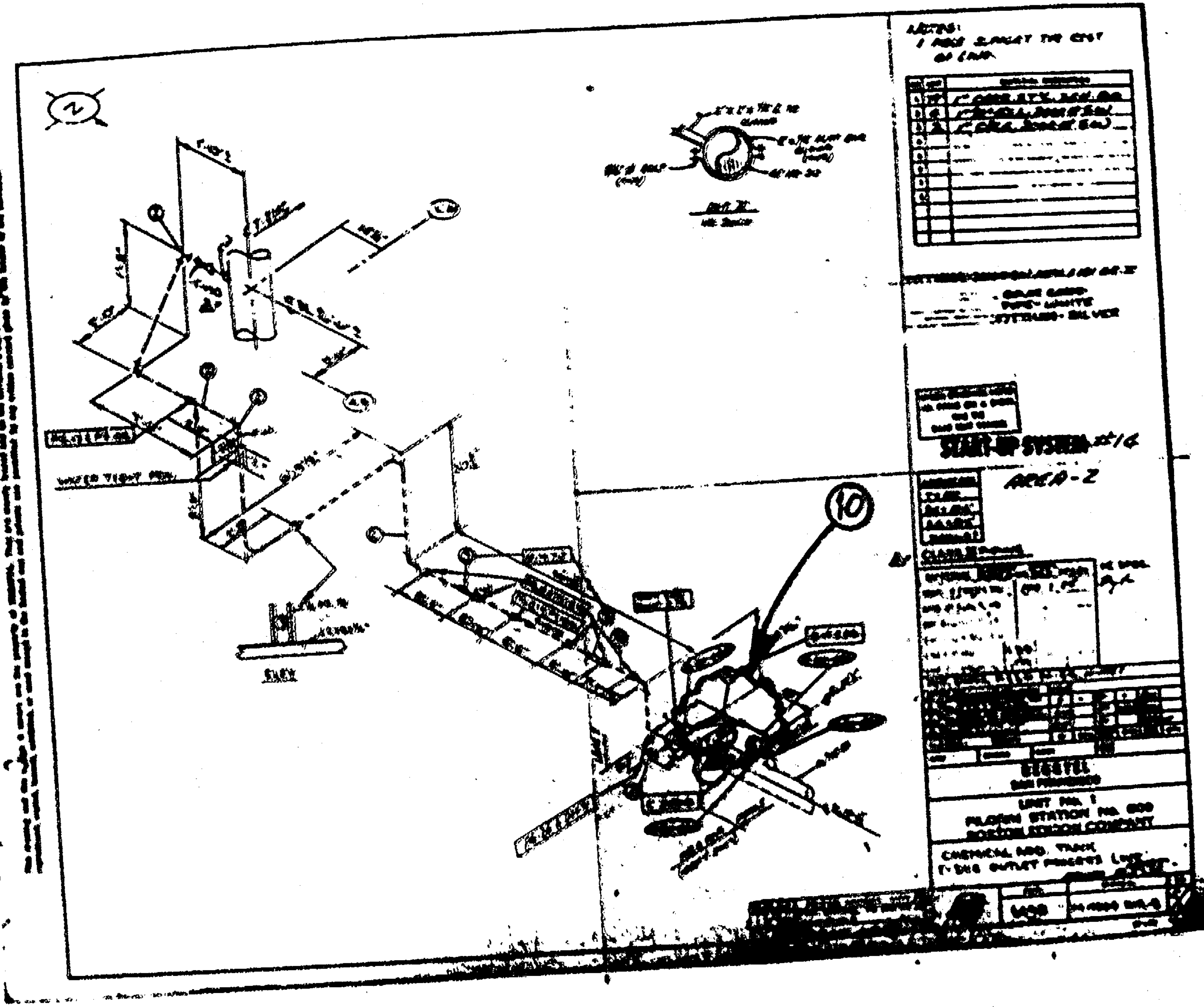
Y
X
Z
N
H-30-1-90
14"-HE-30
20'-6⅝"
14"x12" RED.
20"x14" ECC. RED.
FOR CONT. SEE
P-110B DISCH
EL. 12'-3½"
EL. 8'-4"
2'-2⅝"
9'-11⅝"
7'-3"
7
5
L
REFERENCE:
NOTES:
RESTRAINT
SNUBBER
GUIDE (2 WAY)
SPRING HANGER
ANCHOR
RIGID HANGER
BECHTEL
SAN FRANCISCO
TURBINE BLDG. COOLING WATER SYSTEM P-110B DISCHARGE
6498-631-2



Y
N
Z
X
EL. 12'-3½"
S.R. ELL.
5'-1⅞"
H-30-1-9432
H-30-1-8838
14" HE-30
10'-9"
10'-6⅝"
S.R. ELL.
14" x 12" RED.
H-30-1-90
H-30-1-8836
20" x 14" ECC. RED.
FOR CONT. SEE ISO NO 6498-631-1
P-110B DISCH
EL. 8'-4"
7'-8"
7
5
L
BECHTEL
SAN FRANCISCO
TURBINE BLDG. COOLING WATER SYSTEM P-110B DISCHARGE
6498-631-2
RESTRAINT
SNUBBER
GUIDE(2 WAY)
SPRING HANGER
ANCHOR
RIGID HANGER



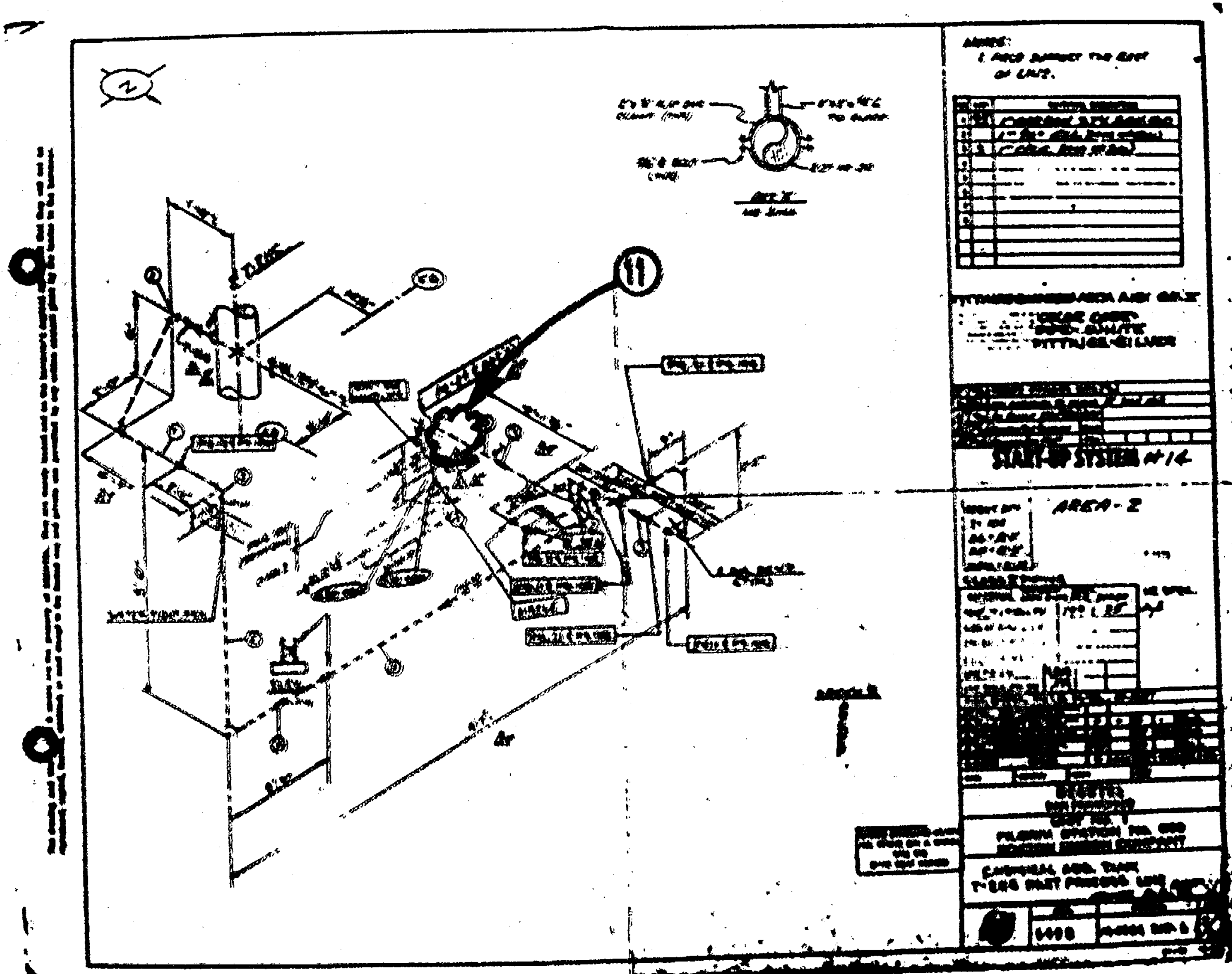
N
Z
X
CONT. ON 6498-
P.E. PENETRATION
BECHTEL
SAN FRANCISCO
TURB. BLDG. COOLING WATER
DISCH. TO AIR CONDITION SYS
6498-632-1
RESTRAINT
SNUBBER
GUIDE (2 WAY)
SPRING HANGER
ANCHOR
RIGID HANGER



START-UP SYSTEM
AREA-Z
WATER TIGHT PEN.
10
UNIT NO. 1
BOSTON EDISON COMPANY

12

13



Author: Richard Pardee at ~Nuclear-Mgmt
Date: 3/11/98 1:54 PM
Priority: Normal
TO: Albert Shatas at ~Nuclear-Oper
CC: Raymond Pace at ~Nuclear-Tech, Charles Garrow, Robert Sheridan at ~Nuclear-Tech
Subject: Attachment 13 Change to PR96.0396.05 Action Item

Al:

As we discussed, see the text below to be included in an Attachment 13 that will revise the inspection criteria established by Ray Pace (MESG) in PR96.0396.05 from VT-1 to VT-2 methods. The following addendum to the original PR evaluation has been discussed with Ray and he agrees with the change from VT-1 to VT-2 based on our experience with this new inspection program during the recent TBCCW outage.

Rich P.

Inspections performed by ISI on three TBCCW inspection points during the March 1998 TBCCW system outage revealed the need to change the type of examination originally specified in PR96.0396.05 from VT-1 to VT-2 methodology. The VT-2 method (ASME XI 1989 edition) will be equivalent to VT-1 but easier and more cost effective to implement over the life of the inspection program since staging and insulation removal/replacement activities will not be required.

For this particular situation (IGSCC in low-stress TBCCW piping), examination using VT-2 methods (a leak check performed to code rules) will be as effective in locating areas of through-wall cracking as the VT-1 method. Since IGSCC initiates from the inside pipe surface, a crack that would be visible from the outside surface using the VT-1 method would have had to propagate through-wall and would already be leaking, allowing detection by the VT-2 examiner.

An MSTP Change Form for Node #5001262 has been submitted to reflect the exam method change.

Richard Pardee

PR — Integrated Action Item Database Revision Form

PR96.0395.06 — Extension: 0

CA

Date: 05/14/97

Responsible Manager: GANNON, C. [illegible] **Status:** ~~OPEN~~ [illegible]

Group: QAD **Significance:** 2

Department: QC **Strategy:** **Priority:** 9

Sub Department: **Doc Type/Number:**

Title

HIGH NITRATE LEVELS EXIST IN THE TBCCW SYSTEM. HIGH NITRATE CONCENTRATIONS HAVE BEEN ASSOCIATED WITH STRESS CORROSION CRACKING OF CARBON STEEL PIPING.

Rec'd Date:	/ /	**Due Date:**	08/30/97
Assign Date:	05/14/97	**Dead Date:**	08/31/97
Start Date:	05/20/97	**Completion Date:**	/ /

Action

VISUAL INSPECTION PROGRAM DEVELOPED FOR SELECTED POINTS

Closure Requirements

VISUAL INSPECTION PROGRAM IMPLEMENTED

Notes/Basis for Change(s)

ENTERED

Change(s) Approved By: [signature] Manager 5/21/97 Date: 5/19/97

Change(s) Accepted By: [signature] PR Coordinator Date: / / 5/20/97

BASIS

- THE EXAMINATION REQUIREMENTS WILL BE TRACKED BY THE MST TRACKING PROGRAM (ATTACHED FORM) WITH EXAMINATION PERFORMED TO EXISTING PROCEDURES. THE INSPECTIONS WILL BE IMPLEMENTED WITH AN MR AS WITH ALL OTHER I.S.I EXAMINATIONS. CG NODE # S001262

7 9 3 2 0 0 9 1

REPORT DATE: 08:58:15 19 MAY 1997
SSEL NODE: 5006800

MASTER SURVEILLANCE TRACKING PROGRAM
SEMI-ANNUAL REPORT/CHANGE FORM

NEW

1 Title: ~~SPECIFICATION FOR PIPING EROSION/CORROSION MONITORING~~ EXAMINATION OF TBCCW FOR MIC CORROSION CLEANING

2 Procedure Number: ~~SPEC-N-577~~ QCI 50.84 [redacted]

4 Node Number: ~~4803~~ 5001282
Rep Task Number: ~~5006800~~

6 Task Type: ~~A—Regulatory commitment~~ B INTERNAL COMMITMENT

7 Frequency: 46 1/RO
8 Schedule Basis: 1
9 Lead Division: 18 QUALITY CONTROL
10 Owner: 18 QUALITY CONTROL
11 Notes/Work Instructions: ~~PERFORM UT INSPECTION OF POINTS SELECTED BY AND IN PROCEDURE SPEC-N-577. THIS SHOULD BE DONE EVERY REFUELING OUTAGE~~ Perform a UT examination of 5 of 11 components each RFO. 11 components are in program and all must be inspected twice in 5 RFO's.

12 Current Mode: ANY
13 Max Tasks to Generate: 1
14 Unit Mode: COLD SHUTDOWN
15 Systems:

17 Commitment/Requirement: ~~[illegible] GENERIC LETTER 89-08; NECO [illegible]~~ PROBLEM REPORT 96.0396.06

18 Notices: A; P; F
19 Equipment Tested: PIPING
Related Tests
21 Preceding Tests: IDENTIFY INSPECTION LOCATIONS
22 Concurrent Tests:
23 Proceeding Tests:
Schedule Info NEW
Done On: ~~05/15/97; 05/15/95; 05/12/93~~
Due On: RFO-12(S); ~~RFO-11(S); RFO-10(S)~~
Dead On: RFO-12(E); ~~RFO-11(E); RFO-10(E)~~
28 IST Status: NO
IST Test Results
30 IST Test Results: N/A
31 Alert Components: N/A
32 Triggers:
33 Triggered By:
34 Comments: NO_OUTAGE_1; NO_SU; NO_OUTAGE_2; NO_OUTAGE_3; SNR

Submitter: [signature] 5/13/97

Div. Rep Task Coord.: [signature] 5/13/97

*Source Mgr.: R. [signature] 5/13/97

*System Engr.: ____________ __/__/__ RCM Impact Y/N N

Plant Rep Task Coord.: [signature] 5/19/97

*required for non-conservative commitment/requirement changes

Note: A Technical Basis is required for changes to the MSTP Database.

ORIGINAL

EXHIBIT 1
Sheet 1 of 2

Problem Report 96.0396

RType G7.07

PROBLEM REPORT

PART A - ORIGINATOR REPORT

Problem Reported By: DAVID COUNTAW Group/Dept: CHEMISTRY Date: 9-23-96 Ext.: 2511

Problem Date: 9-23-96 Time: 1200

1. Describe the Problem and how found: High nitrate levels exist in the TBCCW system. Chemistry trending of the TBCCW system indicated decreasing nitrite levels and increasing conductivity. Special testing for nitrates was performed and indicated 945 PPM. By comparison A+B RBCCW have 39 PPM. High nitrate concentrations have been associated with stress corrosion cracking of carbon steel piping.

2. Identify the System, Component, or Part involved (if known):

	Name	Number	Location
a. System/Loop	TBCCW		
b. Component			
c. Part			

3. Describe the System Component or Part Function(s) (if known)

Name	Description

4. What was the Probable Cause of the Problem? corrosion inhibitor sodium nitrite being converted to nitrate by excess oxygen or bacteria

5. Was a Work Request Tag placed on the Identified Component? ___ Yes X No WRT# ______

6. Radiological Problems? ___ Yes X No

NOTE

If the problem meets the criteria on the back of this page, hand carry this form to the NWE immediately.

(Front of Form)

RType G7.07

Problem Report 96-0394

ORIGINAL

PROBLEM REPORT

1. ___ N/A Findings:
   - ___ Comparable internal problems or recurring deficiencies
   - ___ Comparable external (OER and NPRDS) problems
   - ___ Duplicate problem (exact)
   - ___ Adverse trend (preliminary)

   None

2. ___ N/A Significance:
   ___ Level I ✓ Level II ___ Level III ___ Level IV // Criterion
   Notification ___ Yes ✓ No Date: ________ (If yes, complete Exhibit 11)

3. ___ N/A Recommendation:
   ✓ Accept ___ Reject ___ Incorporate into PR AI # ________

4. ___ N/A Disposition:
   - ___ Critique
   - ___ RCA
   - ✓ Evaluation ① Probable Cause ② Effects on material (carbon steel)
   - ___ Corrective Action
   - ___ Close
   - ___ 10CFR21 Applicability Review

5. ✓ N/A a. Hardware Nonconforming Condition: ___ Yes ___ No Additional Actions: ___ Yes ___ No
   If Yes: ___ Rework ___ Use-As-Is AI#: ________
   ___ Scrap or Return ___ Repair

   ✓ N/A b. Hardware Degraded Condition: ___ Yes ___ No Additional Actions: ___ Yes ___ No
   AI#: ________

   ✓ N/A c. System, Structure, Component Is Operable: ___ Yes ___ No
   If Yes, Basis: ________

6. ___ N/A Distribution:
   ___ Yes ✓ No Nuclear Network submission ___ Yes ✓ No Copy to Regulatory Affairs Dept

7. Submitted: [signature] Date: 9/24/96
   Screening Coordinator

8. ___ N/A Other PAC Reviews
   ✓ Yes ___ No After all evaluations
   ___ Yes ✓ No After all corrective actions
   ___ Yes ✓ No Other: ________

9. Approved: [signature] Date: 24 Sep 96
   PAC Chairman

ALERT

THE IADB ITEM DETAILED HERE HAS NOT BEEN COMPLETED AND HAS PASSED ITS DUE DATE OR WILL PASS ITS DUE DATE IF IT FALLS ON A HOLIDAY OR WEEKEND.

ENTERED

IADB ID:	PR96.0396.02
TITLE:	HIGH NITRATE LEVELS EXIST IN THE TBCCW SYSTEM. HIGH NITRATE CONCENTRATIONS HAVE BEEN
Document Type:	
Document No.:	
Action Type:	EVALUATION
STATUS:	OPEN
SIGNIFICANCE:	2
PRIORITY:	A1
Rec'd DATE:	/ /
Start Date:	10/01/96
DUE DATE:	~~[illegible]~~ 12/15/96
DEAD DATE:	~~[illegible]~~ 1/15/97
RESPONSIBLE MANAGER:	PACE, R
DEPARTMENT:	NESG
DIVISION:	CIV MECH
SECTION:	
SUB DIVISION:	
Strategy:	

Awaiting Altran analysis inputs. Change due/dead date as indicated.
Thomas Whited.
11/29/96

Tom
Can we move this a month out?
Thanks
R

QUERY: UPPER(SRC_CODE) = 'PR'

Start Date: 10/31/96 **End Date:** 11/04/96

A. Shates 12/2/96

U U 6 U 8 ...

PR

Integrated Action Item Database Revision Form

PR96.0396.01 Extension: 0

EVALUATION

Date: 11/29/96

Responsible Manager:	FOUNTAIN, D.	**Status:**	OPEN
Division:	NUC SVCS	**Significance:**	2
Department:	CHEMISTY	**Priority:**	A0
Sub Division:		**Doc Type/Number:**	

Title

HIGH NITRATE LEVELS EXIST IN THE TBCCW SYSTEM. HIGH NITRATE CONCENTRATIONS HAVE BEEN ASSOCIATED WITH STRESS CORROSION CRACKING OF CARBON STEEL PIPING.

Rec'd Date:	/ /	**Due Date:**	~~11/01/96~~ 3/15/97
Assign Date:	09/24/96	**Dead Date:**	~~12/01/96~~ 4/15/97
Start Date:	10/01/96	**Completion Date:**	/ /

Action

CONDUCT AN EVALUATION TO DETERMINE THE CAUSE OF THE HIGH NITRATE LEVELS IN THE TBCCW SYSTEM. DETERMINE CORRECTIVE ACTIONS AND ACTIONS TO PRECLUDE RECURRENCE.

Closure Requirements

COMPLETE EVALUATION PER NOP92A1, SECTION 6.4

Notes/Basis for Change(s)

Change(s) Approved By: D. Fountain (signature) Manager Date: ~~/ /~~ 11/29/96

Change(s) Accepted By: (signature) PR Coordinator Date: / / 12/01/96

More time needed for evaluation, in house testing is inclusive and efforts are being made to have samples analyzed by vendor laboratory

PR

Integrated Action Item Database Revision Form

PR96.0396.01 Extension: 2

EVALUATION

Date: 06/24/97

Responsible Manager: LOOMIS, L. Status: OPEN

Group: NUC SVCS Significance: 2

Department: CHEMISTY Strategy: Priority: A0

Sub Department: Doc Type/Number:

Title

HIGH NITRATE LEVELS EXIST IN THE TBCCW SYSTEM. HIGH NITRATE CONCENTRATIONS HAVE BEEN ASSOCIATED WITH STRESS CORROSION CRACKING OF CARBON STEEL PIPING.

Rec'd Date:	/ /	Due Date:	~~06/15/97~~ 8/1/97
Assign Date:	09/24/96	Dead Date:	~~08/30/97~~ 8/31/97
Start Date:	10/01/96	Completion Date:	/ /

Action

CONDUCT AN EVALUATION TO DETERMINE THE CAUSE OF THE HIGH NITRATE LEVELS IN THE TBCCW SYSTEM. DETERMINE CORRECTIVE ACTIONS AND ACTIONS TO PRECLUDE RECURRENCE.

Closure Requirements

COMPLETE EVALUATION PER NOP92A1, SECTION 6.4.

Notes/Basis for Change(s)

DATE EXTENSION REVIEW [11/29/96, FOUNTAIN, D.] MORE TIME NEEDED FOR EVALUATION. IN HOUSE TESTING IS INCLUSIVE AND EFFORTS ARE BEING MADE TO HAVE SAMPLES BY VENDOR LABORATORY

[4/18/97, C. GODDARD] EXTEND DUE TO MANPOWER RESTRAINTS ; extend due to manpower restraints

Change(s) Approved By: [signature] for C. Goddard Date: 6-24-97
Manager

Change(s) Accepted By: [signature] Date: 6/26/97
PR Coordinator

PR

Integrated Action Item Database Revision Form

PR96.0396.03 **Extension: 0**

CA

Date: 02/06/97

Responsible Manager:	[redacted]	**Status:**	OPEN
Division:	NUC SVCS	**Significance:**	N.
Department:	CHEMISTY	**Priority:**	9
Sub Division:		**Doc Type/Number:**	

Title

HIGH NITRATE LEVELS EXIST IN THE TBCCW SYSTEM. HIGH NITRATE CONCENTRATIONS HAVE BEEN ASSOCIATED WITH STRESS CORROSION CRACKING OF CARBON STEEL PIPING.

Rec'd Date:	/ /	**Due Date:**	~~04/01/97~~ 9/1/97
Assign Date:	02/06/97	**Dead Date:**	~~06/06/97~~ 9/30/97
Start Date:	02/06/97	**Completion Date:**	/ /

Action

CHEMISTRY TO SAMPLE AND ANALYZE THE RBCCW AND TBCCW, INCLUDING THE MAKE-UP WATER SOURCE, FOR THE PRESENCE OF NITROBACTER BACTERIA.

Closure Requirements

IF NITROBACTER BACTERIA ARE FOUND A BIOCIDE SHOULD BE INTRODUCED AS A PART OF A CHEMICAL TREATMENT PROGRAM TO ELIMINATE THE BACTERIA AND REDUCE THE NITRATE CONCENTRATION. PROVIDE MEMO DOCUMENTING DETAILS OF TASK COMPLETION.

Notes/Basis for Change(s)

Change(s) Approved By: David W. Fountain Date: 11.5.28.97
Manager

Change(s) Accepted By: [signature] Date: 11 6/2/97
PR Coordinator

Extend due and dead dates due to restraints in procedural revisions to allow samples to be sent off site for vendor analysis.

ENTERED

PR

Integrated Action Item Database Revision Form

PR96.0396.03 **Extension: 2**

CA

Date: 01/07/1998

Responsible Manager: FOUNTAIN, D. **Status:** OPEN

Group: NUC SVCS **Significance:** N.

Department: CHEMISTY **Strategy:** **Priority:** 90

Sub Department: **Doc Type/Number:**

Title

HIGH NITRATE LEVELS EXIST IN THE TBCCW SYSTEM. HIGH NITRATE CONCENTRATIONS HAVE BEEN ASSOCIATED WITH STRESS CORROSION CRACKING OF CARBON STEEL PIPING.

Rec'd Date:	/ /	**Due Date:**	~~12/01/97~~ 3/1/98
Assign Date:	02/06/1997	**Dead Date:**	~~12/31/97~~ 4/1/98
Start Date:	02/06/1997	**Completion Date:**	/ /

Action

CHEMISTRY TO SAMPLE AND ANALYZE THE RBCCW AND TBCCW, INCUDING THE MAKE-UP WATER SOURCE, FOR THE PRESENCE OF NITROBACTER BACTERIA.

Closure Requirements

IF NITROBACTER BACTERIA ARE FOUND A BIOCIDE SHOULD BE INTRODUCED AS A PART OF A CHEMICAL TREATMENT PROGRAM TO ELIMINATE THE BACTERIA AND REDUCE THE NITRATE CONCENTRATION. PROVIDE MEMO DOCUMENTING DETAILS OF TASK COMPLETION

Notes/Basis for Change(s)

[5/28/97 FOUNTAIN, D] EXTEND DUE AND DEAD DATES DUE TO RESTRAINTS IN PROCEDURAL REVISIONS TO ALLOW SAMPLES TO BE SENT OFFSITE FOR VENDOR ANALYSIS.

[7/14/97 FOUNTAIN, D] MORE TIME NEEDED TO COMPLETE. REVISED ACTION PLAN (SEE RESPONSE TO PR96 0396 01)
1) CHEMISTRY WILL DEVELOP A P O FOR VENDOR LAB ASSISTANCE THAT WILL ANALYZE FOR THE PRESENCE OF BACTERIA KNOWN TO CAUSE THE PROBLEM SEEN IN TBCCW 9/15/97
2) CHEMISTRY WILL SAMPLE FOR BACTERIA IN TBCCW AND SEND TO VENDOR FOR ANALYSIS 10/15/97
3) CHEMISTRY WILL FURTHER EVALUATE THE CAUSE TO TBCCW HIGH NITRATES AFTER RESULTS OF LAB ANALYSIS ARE RECEIVED 12/1/97

[1/7/98 FOUNTAIN, D] PLEASE EXTEND DUE AND DEAD DATES. ADDITIONAL TIME IS NEEDED BECAUSE SAMPLING MUST COINCIDE WITH MAINTENANCE OF SLIPSTREAM FILTER. MAINTENANCE IS SCHEDULED FOR MARCH 98. IN HOUSE TESTING HAS SHOWN NO INDICATION OF BACTERIA

EXTENDING THIS ACTION ITEM
1) WILL NOT IMPACT NUCLEAAR, INDUSTRIAL OR RADIOLOGICAL SAFETY
2) WILL NOT ADVERSELY AFFECT QUALITY

Change(s) Approved By ______ Manager Date: 1/8/98

Change(s) Accepted By ______ PR Coordinator Date: 1/13/98

PR

Integrated Action Item Database Revision Form

PR96.0398.02 Extension: 0

EVALUATION

Date: 09/24/96

Pace, R.

Responsible Manager: BURNS, T. #4

Division: NESG

Department: P&QE

Sub Division:

Status: OPEN

Significance: 2

Priority: A

Doc Type/Number:

Title

HIGH NITRATE LEVELS EXIST IN THE TBCCW SYSTEM. HIGH NITRATE CONCENTRATIONS HAVE BEEN ASSOCIATED WITH STRESS CORROSION CRACKING OF CARBON STEEL PIPING.

Rec'd Date:	/ /	**Due Date:**	11/01/96
Assign Date:	09/24/96	**Dead Date:**	12/01/96
Start Date:	10/01/96	**Completion Date:**	/ /

Action

DETERMINE THE EFFECTS OF THE ELEVATED NITRATE LEVELS ON THE CARBON STEEL PIPING OF THE TBCCW SYSTEM.

Closure Requirements

MEMO DETAILING THE RESULTS THE EVALUATION AND THE REQUIRED CORRECTIVE ACTIONS. CONCURRENCE MUST BE OBTAINED FROM ACTION ITEM OWNERS.

NOTE: CHEMISTRY HAS ALSO BEEN ASSIGNED AN ACTION TO DETERMINE THE CAUSE OF THE EXCESS NITRATE AND SHOULD BE ABLE TO PROVIDE ADDITIONAL INFORMATION TO ASSIST IN YOUR EVALUATION.

Notes/Basis for Change(s)

See below

Change(s) Approved By [illegible signature] Manager Date: 9/26/96

Change(s) Accepted By ______________ PR Coordinator Date: / /

Please review this PR + Mechanical-Civil/Structural [illegible] department [illegible] agreement with [illegible] that [illegible] will support [illegible] as needed [illegible] manpower [illegible] that [illegible] will [illegible] issue.

PR

PR96.0396.03 **[illegible]: 1**

CA

Date: 07/14/97

Responsible Manager: FOUNTAIN, D. PLG52 **Status:** OPEN

Group: NUC SVCS **Significance:** N.

Department: CHEMISTY **Strategy:** **Priority:** 93

Sub Department: **Doc Type/Number:**

Title

HIGH NITRATE LEVELS EXIST IN THE TBCCW SYSTEM. HIGH NITRATE CONCENTRATIONS HAVE BEEN ASSOCIATED WITH STRESS CORROSION CRACKING OF CARBON STEEL PIPING.

Rec'd Date:	/ /	**Due Date:**	~~09/01/97~~ 12/1/97
Assign Date:	02/06/97	**Dead Date:**	~~09/30/97~~ 12/31/97
Start Date:	02/06/97	**Completion Date:**	/ /

Action

CHEMISTRY TO SAMPLE AND ANALYZE THE RBCCW AND TBCCW, INCUDING THE MAKE-UP WATER SOURCE, FOR THE PRESENCE OF NITROBACTER BACTERIA.

Closure Requirements

IF NITROBACTER BACTERIA ARE FOUND A BIOCIDE SHOULD BE INTRODUCED AS A PART OF A CHEMICAL TREATMENT PROGRAM TO ELIMINATE THE BACTERIA AND REDUCE THE NITRATE CONCENTRATION. PROVIDE MEMO DOCUMENTING DETAILS OF TASK COMPLETION.

Notes/Basis for Change(s)

[5/28/97, FOUNTAIN, D.] EXTEND DUE AND DEAD DATES DUE TO RESTRAINTS IN PROCEDURAL REVISIONS TO ALLOW SAMPLES TO BE SENT OFFSITE FOR VENDOR ANALYSIS. MORE TIME NEEDED TO COMPLETE REVISED ACTION PLAN. (SEE RESPONSE TO PR960396.01.)

Change(s) Approved By: [signature] Date: 7/14/97
Manager

Change(s) Accepted By: [signature] Date: 7/15/97
PR Coordinator

ENTERED

1) CHEMISTRY WILL DEVELOP A P.O. FOR VENDOR LAB ASSISTANCE THAT WILL ANALYZE FOR THE PRESENCE OF BACTERIA KNOWN TO CAUSE THE PROBLEM SEEN IN TBCCW. 9/15/97

2) CHEMISTRY WILL SAMPLE FOR BACTERIA IN TBCCW AND SEND TO VENDOR FOR ANALYSIS 10/15/97

3) CHEMISTRY WILL FURTHER EVALUATE THE CAUSE OF TBCCW HIGH NITRATES AFTER RESULTS OF LAB ANALYSIS ARE RECEIVED. 12/1/97