Topical Report 116
Revision 3

Oyster Creek Underground Piping Program Description and Status

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Executive Summary

This Topical Report provides a program description and the current status (as of November 2009) of the Oyster Creek Underground Piping Program.

The objective of the program is to ensure that the material condition of Oyster Creek underground piping will remain satisfactory until the end of 2029, considering Nuclear Safety, Environmental Regulations, Plant Availability, and System Reliability. (CM-1)

This objective is achieved with the following program elements:

1) Investigate operating history related to underground piping leaks
2) Perform Risk Evaluations of underground piping on the Oyster Creek Site (CM-1).
3) Prioritize underground lines based on evaluation and operating history
4) Perform inspections and tests on high and medium priority systems and at target of opportunity in low priority systems
5) Analyze to determine generic failure mechanisms and corrective actions
6) Evaluate, justify and sponsor modifications and tests
7) Designate low priority piping in which no preventive actions will be taken and leaks will be repaired as they occur.

The following are significant program accomplishment::

1) In 2008, Oyster Creek replaced the remaining 50% of all underground Safety Related ESW piping; approximately 300 linear feet. In 2004, Oyster Creek had replaced the other 50%. Therefore, as of 2008, 100% of Safety Related Underground ESW piping has been replaced and the Risk Ranking for these lines has been revised and is no longer considered "High Risk".

2) In 2004 and 2008, Oyster Creek replaced approximately 20% of all underground Service Water System piping; approximately 150 linear feet. The remaining 80% is planned to be rehabilitated in 2010.

3) In 2008, Oyster Creek Engineering developed a series of technical evaluations that demonstrated that ESW System 1 could be used as an alternate source of RBCCW Heat Exchanger cooling with the plant online. The technical evaluations became the basis for operating procedure changes. The revised operating procedures gave Oyster Creek the capability for taking the Service Water System out of service for maintenance for short durations with the plant online. This mode of operation takes advantage on the ESW to Service Water System crosstie line, which was sponsored by this program and installed in 2002. In early of 2008 the revised procedures were used to mitigate an underground Service Water Line leak. The Service Water System was taken out of service for repairs while the plant remained on line. This was a first time evolution in the history of Oyster Creek.

4) In 2008, Oyster Creek replaced all three chlorination lines to the ESW and Service Water System. The new lines are double wall pipe. The Risk Ranking for these lines has been revised and is no longer considered "High Risk".

5) In 2008, the program performed coating inspections on 6 lines in the southeast vault. This inspection is now required as a new Repetitive Task (PM57304M). This PM opens and drains water out of the vault. The inspection found that the coating on five lines had broken down and require repair. An IR (00813967) was issued to document this condition. The IR was accompanied by an evaluation, which concluded that the coating conditions did not pose an immediate operability concern. Repairs are planned per work order R2130898.

6) In 2008, the program excavated and inspected a 6" Condensate Transfer line located west of the Turbine Building. The inspection showed that the coating was in good condition.

7) In 2006, approximately 1000 feet of Fuel Oil Transfer Piping was replaced with double walled pipe and leak detection instrumentation. The approximate cost of the project was $600,000. This project reduced risk from Oyster Creek's highest risk underground systems.

The following significant corrective actions have been sponsored and are planned in the near future.

1) Inspection of three AOG Offgas lines before by December 2010 (IR 00686711).

2) Inspection of two 36" and 48" Offgas Holdup Lines by 2010 (IR 00698332).

3) The Program will sponsor a modification to replace underground small-bore lines which pose operational or environmental risks (IRs 00861654, 00861649, and 00861645).

4) Upon entering the period of extended operation, focused inspection of buried piping and components will be performed within ten years, unless an opportunistic inspection occurs within this ten-year period. The inspections will include at least one carbon steel, one aluminum and one cast iron pipe or component. In addition, for each of these materials, the locations selected for inspection will include at least one location where the pipe or component has not been previously replaced or recoated, if any such locations remain. The stainless steel piping in the vault will continue to be periodically inspected, and the bronze material is addressed by the buried carbon steel pipe coating inspections. **(CM-1)**

2.0 Table of Contents

3.0 Purpose
This Topical Report describes the Oyster Creek Underground Piping Program and provides a status as of November 2007. It is intended that this report will be updated periodically (approximately every two years).

4.0 Program Background
In the early 1990's after several events in which underground piping developed leaks, station management recognized that the material condition of underground pipe at Oyster Creek should be ascertained. In addition, generic and common failure mechanism for underground piping should be identified and corrected. As a result, the station initiated the Oyster Creek Underground Piping Program.

4.1 Program Objective
The objective of the program is to ensure that the material condition of Oyster Creek underground piping remains satisfactory until the end of plant life, considering Nuclear Safety, Environmental Regulations, Plant Availability, and System Reliability.

In 2007, Exelon developed a Corporate program for raw water systems and underground piping (procedure ER-AA-5400). Oyster Creek became one of four Exelon plants to pilot the program. Revision 2 of this report provides a description of the program's transition to new Exelon Program.

4.2 Responsibilities
Program administration is the responsibility of the Oyster Creek Programs Branch within the Engineering Department.

5.0 Program Elements
This section describes the basic elements of the program

5.1 Operating Experience
Significant input to the program is operating experience. As events occur at Oyster Creek related to underground piping leaks, the station ensures that the Programs Branch monitors related activities. The plant Corrective Action Process is used to track root cause and corrective actions. The Programs Branch reviews and evaluates events for generic and common mode failures. Appendix #1 provides a listing of significant underground leaks and the possible root cause of each.

5.2 Evaluations

5.2.1 Initial Review - 1991
In 1992, the program created an inventory of systems that had direct buried underground piping. A matrix was then developed which established the priority of each system plant based on Nuclear Safety, Environmental Impact, affect on

Plant Availability, and System Reliability (see appendix 2). The matrix then prioritized each underground system as follows:

> Priority #1 – Systems that would have an immediate safety significance to the plant or create a significant environmental hazard if a leak were to develop.
>
> Priority #2 – Systems that would require an eventually plant shutdown or an environmental impact.
>
> Priority #3 – Systems that would not cause an immediate safety concern or a plant shutdown, and would not result in an environmental hazard if a leak were to develop.

In general, inspections and testing were performed in the early 1990's for priority #1 systems. Section 7.0 provides a summary of the status of these systems.

5.2.2 1997 Review
In 1997, a more refined review was performed of the program inventory. The review focused on system with underground pipe that contain contaminated fluids. The review, in general, did not look at the priority #1 systems from the 1991 review since activities were already underway to address identified problems. This review focused on the priority #2 and some priority #3 systems. The review focused on the susceptibility of each line for developing a leak and the radiological and environmental consequences of leaks should they occur. A revised matrix was developed in which the susceptibility and consequence of a leak were evaluated (ref. 10.11).

5.2.3 2005 Review
In 2004, Exelon announced the decision to pursue Licensing Life Extension of Oyster Creek to 2029. Therefore, since the 1991 and 1997 reviews did not consider operating Oyster Creek past 2009, the underground piping inventory was again evaluated. The evaluation focused on the susceptibility of each line developing a leak prior to 2029 and the radiological and environmental consequences of leaks should they occur. The revised matrix is documented in appendix 4 and 6 and new evaluations are documented in section 8. Resulting action items are tracked in section 9. TDR 1218 will no longer be updated.

5.2.3 2007 Risk Review
Prior to 2007, each system in the program was evaluated for risk as single lines, which could be hundreds of feet long. In 2007 a new Risk Rank Evaluation was performed at a more refined level. All underground lines in the program were segmented in approximate 20-foot lengths. Then each segment was risk ranked. The evaluation developed a segment data based that captures specific information for each segment and computes a risk ranks for every segment in accordance with ER-AA-5400. The results of this evaluation can be found in reference 10.23 and are consistent with the previous 1997 and 2005 evaluation. However, some

inconsistencies do exist between the 2005 system risk rank evaluations and 2007 segmented risk rank evaluation. These differences will be resolved as the program continues to transition to the guidance of procedure ER-AA-5400. Section 7 and 8 document the reconciliation between high risked systems based on the 2005 system evaluation and the 2007 segmented evaluation.

5.3 Piping Inspections

As a result of the 1991 review, a series of underground piping inspection were performed between 1991 and 1995. This was done by either excavating to the underground line to inspect external conditions or by internal video inspections.

Underground piping inspections have also been performed during targets of opportunities in which excavations were already being performed for other reasons. This is considered cost effective since the cost of excavating piping is expensive. Whenever an underground line leaks and is excavated for repair the root cause of the leak is investigated and the line is inspected to the greatest extent possible. In addition, any other lines that are in the excavation footprint are also inspected. Inspection results are incorporated into the program.

In 2007, new inspection technology (Guided Wave) was implemented to ascertain the condition of high priority lines. Results of the inspections are documented is sections 7 and 8 and in reference 10.24.

Appendix 3 provides a listing of all program related inspections.

5.4 Analysis

Based on the results of operating history, program evaluations, inspections, and the priority of the affected systems corrective actions are developed.

5.5 Modifications

For those generic mechanisms on systems with high priority, modifications have been evaluated and if cost justified recommended to plant management. Completed and ongoing modifications are documented in section 6. Proposed modifications to the ESW and Service Water System are tracked in section 9.

5.6 Periodic Testing

Oyster Creek utilizes the pump IST flow surveillances of various systems to demonstrate that the underground lines are not leaking, and as method of detecting a potential underground leak. Therefore, in 2008 applicable surveillance procedures were revised to alert operators that one of the possible reason for a pump IST failure could be an underground leak.

The table below provides a list of systems and surveillances.

Line /System	ST /Procedure	Frequency
ESW System 1	607.4.017	Quarterly
ESW System 2	607.4.017	Quarterly
Service Water	641.4.001 641.4.006	Quarterly
Condensate Transfer System	644.4.002	Quarterly
RBCCW System	642.4.001	Quarterly
Fire Protection	645.6.023	Yearly
Turbine Dirty Lube Oil Transfer Lines	Pressure test prior to use during a Refueling Outage.	Every time the lines are used See Section 7.5

5.7 Operate Until Failure

For underground piping with #3 priority, there is no cost justification for wholesale changes. Therefore, the program has determined that these systems will be repaired as leaks occur.

5.8 Implementation

Program inspections, tests, and corrective action are typically implemented per IRs and PIMS ARs with approval by PHC (Plant Health Committee) and PRC (Plant Review Committee). Complicated inspections and modifications that require excavation are typically performed per engineering approved specifications. Piping and coating degradation are typically identified, tracked and corrected per the CAP process. Operating procedure changes and periodic surveillances are implemented through the plant procedure change process. Modifications to piping are developed, approved, and implemented through the Oyster Creek Project Approval Process

6.0 Generic Problems (CM-1)

The program has identified several generic problems with underground piping. Below is a summary of each generic problem.

6.1 Aluminum Underground Piping

Operating experience and numerous inspections has shown that there is a generic degradation mechanism with underground aluminum piping. The root cause of the mechanism is localized external coating failure and galvanic corrosion. As a result, the program has designated underground aluminum piping as having a high risk of developing leaks.

Plant experience shows that direct buried aluminum lines have leaked many times at Oyster Creek. In the past 15 years, Oyster Creek has replaced all but four of its consequence significant direct buried aluminum lines with above ground pipe. Past experience indicates that the service life of direct buried aluminum lines at Oyster Creek is 15 to 20 years. For example, the Condensate and Demineralized Water Transfer Pump Recirculation lines (WD-1 and WD-2) developed leaks and were completely replaced (with direct buried pipe) in 1980. These same lines again developed leaks in 1992 and 1996 and were again replaced, this time with above ground piping.

The primary contributor the high corrosion rate of buried aluminum pipe at Oyster Creek is galvanic corrosion. The galvanic mechanism is primarily due to the interaction between the aluminum pipe wall and the large copper grounding grind located on the west side of the plant. The grounding grid protects the main transformers and other electrical equipment and lies in the same footprint as the majority of the direct buried aluminum pipe; before it was replaced by above ground pipe. The dissimilar metals and moisture in the soil result in a high electrical/chemical potential that drive the galvanic corrosion. Corrosion occurs in local areas where the coating was not properly applied or has broken down.

6.1.1 Condensate Transfer System

The program has designated the Condensate Transfer System as a high consequence system. This is due to potential environmental consequences should system develop underground piping leaks and the possibility that a leak would force a plant shutdown.

A decision was made to relocate a significant portion of the underground system piping to either above ground, in engineered trenches, or in vaults. A modification was performed in 1996, which relocated the bulk of the system (ref.10.15). To date, only a few aluminum Condensate Transfer System lines (4) remain underground in contact with soil (see appendix 4). Inspection and modification of these lines are tracked in section 9. In 2007, the four remaining lines were inspected by Guided Wave Technology.

In 2008, a section one of these (line A-4) was excavated and inspected in accordance with procedure ER-AA-5400-1002. The coating system on this line was installed in 1992. The results of the inspection showed that the external condition was acceptable (see section **8.2.2.2**)

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007 and the 2005 evaluation both consistently rank the remaining four direct buried Aluminum Condensate Transfer Lines with High Risk.

6.1.2 Demineralized Water Systems

The remaining bulk of all other underground aluminum piping at Oyster Creek is mostly the Demineralized Water System. In 1998, a modification was performed to relocate all direct buried aluminum pipe with above ground pipe with the exception of one line (A-9) that provides Demineralized Water to the Reactor Building. The one exception was replaced in 1993 with direct buried pipe. The risk and consequence of a leak on this line has been assessed as low.

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2005 and the 2007 evaluation both consistently rank the remaining direct buried Aluminum Demineralized Water Lines with Low Risk.

6.2 Salt Water Systems with Carbon Steel Piping with Internal and External Coal Tar Coatings

Operating experience and inspections has shown that there is a generic degradation mechanism with salt-water underground carbon steel piping with internal Coal Tar Coating. The root cause of the mechanism is that the coating system has reached its end service of life. The mechanism results in localized coating failures.

For internal coating, the localized failure allows salt water to come in contact with the carbon steel-piping wall, which results in pitting corrosion. Based on inspection of above ground piping the ESW and Service Water Systems have and will continue to experience internal localized coating failure (TDR 829). Based on inspections actual corrosion rates have been observed in both systems after the internal coating has degraded. It has been concluded that ESW System piping components that have experienced internal coating failure are corroding at a rate of approximately 12 mpy +/- 4 mpy and Service Water System piping components that have experienced internal coating failure are corroding at a rate of approximately 10 mpy +/- 6 mpy (TDR 829).

For the external coating, the localized coating failure allows groundwater to come in contact with the carbon steel pipe wall, which may result in pitting corrosion or galvanic corrosion.

6.2.1 Service Water and ESW Systems

The Service Water and ESW Systems have been designated as high consequence systems. This is due to the possibility that a significant underground leak in these systems could force plant shutdowns.

In 1992, a 20" underground Service Water line developed a leak. Since the leak located on piping approximately 23 feet below grade, extensive excavation was required to repair the line. Between 1992 and 2000, the Service Water System developed two additional underground pipe leaks that required extensive excavations. Also since 1992, numerous leaks have occurred on above ground Service Water and Circulating Water system lines that have the same coal tar coating. During the repair of these lines, the piping internal coating of was closely inspected. In some cases the inspections showed severe pitting corrosion.

Numerous activities have been performed to investigate potential solutions. The bulk of the 600 feet of Service Water and approximately 100 to 150 feet of ESW system underground piping has been internally inspected by a robotic video camera. Results of the video inspection show no significant gross degradation. However, since the piping internal is covered with silt and biological growth, the remote videos cannot show the actual condition of the pipe coating below the silt and biologic growth. The videos do show evidence of what appears to be "rust blooms" in the silt and biological growth.

In August 2001, ESW System 2 developed an underground leak near the Startup Transformer and the Condensate Transfer Building (CAP 2001-1233). The leak put Oyster Creek in a seven day LCO (Limiting Condition of Operation). The leak had to be repaired in seven days or the plant would have to shutdown. The actual leak occurred at an underground branch connection located 23 feet below grade. A similar leak occurred in 1996 on the Service Water System. The leaking area was too deeply buried and located under important plant equipment and could not be safely excavated in time to meet the 7 day deadline. Therefore, the decision was made to run approximately 250 feet of 14" pipe to bypass the leak. Since the plant only had seven days to install the new pipe, the decision was made to install uncoated carbon steel pipe, which has a limited service life in salt water.

In 2004, Oyster Creek again replaced this line, the same redundant line on the ESW System 1, and a similar Service Water System line. All three of these lines had a similar underground branch connection configuration. The original lines were direct buried 23' feet below grade while the new lines are within 5 feet of grade. The project replaced approximately 50% of all safety related ESW underground piping and 10% of all Service Water System Underground Piping.

A second phase was completed in 2008. With this second phase the remaining 50% of underground safety related ESW piping and an additional 10% of all Service Water System Underground Piping was replaced. The replacement of the ESW line became a commitment to the NRC for License Renewal (Passport assignment 00330592.26). Therefore, risk of an underground safety related ESW

System leak has been significantly reduced and the Risk Evaluation for the ESW System has been revised (Appendix 2, 4 and 5) and no longer considered "High Risk".

A third phase is planned for completion in 2010. This phase should install Cured In Place Pipe (CIPP) in the remaining underground portions of the Service Water System not modified in the previous two phases.

In early 2008, an underground leak developed on a portion of the Service Water System near the Intake. This portion of the system was to be replaced later in the year. In response, Oyster Creek Engineering developed a series of technical evaluations that demonstrated that ESW System 1 could be used as an alternate source of RBCCW Heat Exchanger cooling with the plant online. The technical evaluations became the basis for operating procedure changes. The revised operating procedures gave Oyster Creek the capability for taking the Service Water System out of service for a short duration to repair the leak while the plant remained on line. This new mode of operation took advantage on the ESW to Service Water System crosstie line, which was sponsored by this program and installed in 2002. The Service Water System was taken out of service for repairs while the plant remained on line. This was a first time evolution in the history of Oyster Creek. The new operational mode is available in the future in case the Service Water System again develops a leak.

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007 and the 2005 evaluation both consistently rank underground portions of the ESW and Service Water System with high risk.

6.2.2 Thirty Inch Over-board line
In 1991, the 30" Overboard Discharge line was designated as a medium consequence line system since a leak in this line would complicate plant operation.

In 1993, this line developed a significant leak in an area just down stream of an elbow located approximately 10 feet from the line discharge point at the discharge canal. The root cause was attributed to flow impingement on this downstream side of the elbow. The impingement is due to excessive velocities at this point, which worn away the internal coating and then allowed corrosion. A repair was performed 1994 by replacing an approximate 15-foot length of the line up to the discharge point. The repair included he application of an epoxy-based coating specifically intended for high velocities and abrasive environments

In 1994, an internal robotic video inspection was performed on the bulk of this line during the repair. The inspection showed no gross degradation. Although the video showed evidence of the localized pitting, the structural integrity of the pipe remains un-compromised. This line is a gravity drain line and therefore is under a small amount of pressure.

In 1999 this line developed a large leak near the Service Water Seal Well close to and almost under the foundation to the Drywell Airlock. As result in 2000 Oyster Creek installed Cured In Place Pipe (CIPP) in the entire length of the 30" Overboard Discharge Line (reference OC-MD-H496-001). The completion of this project ensured that this line would be capable of performing its design function past 2029. The line is now considered a low risk.

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007 and the 2005 evaluation both consistently rank the 30 Inch Overboard Discharge Line with Low Risk.

6.2.3 New Radwaste Service Water System

This system is not applicable to the generic mechanism since the piping coating system consists of internal cement lining and the external is an epoxy-based coating.

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007 and the 2005 evaluation both consistently rank this system with Low Risk.

6.3 Separation of Internal Coal Tar Coating

Operating experience and inspections has shown that there is a generic degradation mechanism in which carbon steel piping with internal Coal Tar Coating experiences internal coating delaminating and separates from the piping in large pieces. In 1985, an event occurred in which a large amount of delaminated coating broke away from ESW internal piping and blocked the Containment Spray Heat Exchangers. Investigation into the root cause showed that the coating had degraded in ESW piping, which was located submersed in the plant intake. The root cause of the event was determined to be repeated temperature cycling of the coating material. This failure mechanism was evaluated to be limited only to ESW piping submersed in the intake.

This mechanism results in two potential adverse affects on the system. First, the large pieces of coating travel down the system and block system heat exchanger tube sheets. Since the system operates intermittently and not continuously, the heat exchangers in a 1985 event were significantly blocked. The second adverse affect is that the piping internal walls are no longer protected from the salt-water environment. Therefore the ESW system has been designated as a high-risk system.

Corrective action at the time was to remove all internal coating in ESW piping submersed under the intake. This corrective action eliminated the build-up of coating material on the system heat exchangers but increased the corrosion of the piping that was stripped of internal coating.

In 1992 and 1993, the submerged piping was inspected and with some pipe replaced and coating repaired.

In 1R20 (2004), UT inspections were performed on the Service Water and ESW System headers submerged in the north intake bay using a diver to control the UT probe. Results of the inspection on the Service Water Pipe in the north intake bay showed that the external coating is in good condition. With the exception of one local area with internal corrosion, no external or internal coating breakdown was observed. The remaining piping wall was measured at nominal thickness. The one degraded area will not corrode to below Tmin until at least 2010. This inspection provides confirmation that the coating system applied in 1992 and 1993 is not significantly degrading. AR A2047021 will track inspections of the south intake bay in 1R21.

The mechanism seems to have been limited to piping submersed under the intake. Activities to monitor inspect, and correct the problem have been managed in separate activities and not directly through the Underground Piping Program, however the program has monitored activities related to this event for applicability to underground piping.

6.4 High Risk Small bore lines

In 2008, it became apparent that there were a number of small-bore direct buried lines that pose high risk. These are lines that carry contaminated fluid which, if they leaked, could result in unmonitored radiological releases and/or plant transients. Because of their size these lines cannot be inspected using Guided Wave or "C Scan" Technology. Given that these lines will be expected to be in service for up to 60 years, it was decided that projects will be pursued to replace these lines with aboveground lines.

These lines are:

1) A 1" carbon steel Reactor Cleanup Sludge Transfer line (CS-1) to Radwaste and 1 ½" RBEDT line to Radwaste (CS-5). These lines are located approximately 5 to 6 feet below grade south of the Reactor Building. Although these lines were inspected in 1997 and repaired, the inspection was only an external visual inspection. Since these lines transfer highly contaminated water, the consequences of a leak would be severe due to the high contamination levels of the sludge. IR 00861649 has been submitted to replace these lines.

2) An approximate 600' long 1 ½" and 2" brass Instrument Air line (CS-37) that runs from the southwest corner of the Turbine Building to the Condensate Transfer Building and to the Intake. Except for a small portion near the intake road, this line has never been inspected. The small portion (less then 7 feet) near the intake road was inspected during a 2004 excavation (with no degradation observed). A leak of this line could result in a plant transient. IR (00861654)has been submitted to replace this line.

3) Two carbon steel 1-inch lines which run from the Turbine Building to either the Condensate Building or to the CST. One line is direct buried between the

condensate Building and the Turbine Building (CS-26) and supplies flow from the Hotwell Level Control System to the Condensate Pump Seals, only during plant startup and shutdown. The other line runs from the Northeast Corner of the Turbine Building to the CST (CS-38) and provides minimum recirculation flow from the CRD Pumps.

These lines were assessed as a medium risk factor since they are direct buried and could result in an unmonitored radiological leak and possibly lead to a plant shutdown. IR 00861645 has been submitted to replace these lines.

7.0 Priority # 1 Systems resulting from 1991 Review

7.1 ESW System

Discussed in detail in sections 6.2 and 6.3. The ESW System, as of the 2008 replacement, is no longer considered a priority 1 System.

7.2 Service Water System

Discussed in detail in sections 6.2.

7.3 Condensate Transfer

Discussed in detail in sections 6.1 and 8.2.

7.4 Diesel Fuel Oil Transfer Line

In 1986 this 2" line developed an underground leak that resulted in an unmonitored underground fuel oil release. This has become very expensive, since Oyster Creek is now required to clean up this spill. The line was repaired at the failed location.

In 2004 Oyster Creek made the decision to replace this line and two similar lines. In 2006 these lines were replaced with double wall pipe (ECR 04-00584 and PD 102026). The new lines included the Fuel Oil Transfer Line from the main tank to the EDG Storage Tank, the Fuel Oil Supply Line to the Boiler House, and the Minimum Recirculation line back the to main tank. All three lines are double wall pipe. The inner pipe carries the fuel oil, and the outer pipe contains instrumentation, which will alarm to a panel in the Boiler House in case the inner pipe leaks oil.

The Diesel Fuel Oil Transfer Line, as of the 2007 replacement, is no longer considered a priority 1 system.

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank

The 2007 and the 2005 evaluations both consistently rank underground portions of the Diesel Fuel Oil Transfer Line as High Risk. However, this evaluation did not considered the most recent modification, which replaced these lines with double walled pipe. Therefore the database will require revision in the next update.

7.5 Turbine Lube Oil Transfer Lines

These lines transfer turbine lube oil from the Main Turbine Lube oil Tank to the Storage tank located west of the Turbine Building. The lines are only used during refueling outages when the turbine is overhauled. As a result of the 1991 program evaluation these lines were pressure tested successfully in 1993. This demonstrated that this line had not degraded. Follow-up review of the consequence should this line leak in the future shows that this line should be tested on a periodic basis.

In 2007, about 110 feet of each line were inspected per Guided Wave Technology and were found to be acceptable (reference 10.24)

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007 and the 2005 evaluations consistently rank underground portions of the Turbine Lube Oil Transfer Line as High Risk.

7.6 Fire Protection System
Fire protection system underground piping is made of carbon steel pipe with external coal tar coating and no internal coating. The process water in the system is fresh water supplied by an onsite pond. Operating experience has indicated no generic problems with the system. Inspections during targets of opportunity have shown that the exterior coating is generally in good shape. No further action is planned at this time for this system.

In 2007, about 90 feet of these two lines was inspected per Guided Wave technology and were found to be acceptable (reference 10.24)

In 2008, a small portion of a 14" line was excavated and replaced including Fire Hydrant FH-19. This provided an opportunity to inspect a small section of the underground piping that supplied this hydrant. The inspection showed that the external coating of the carbon steel pipe was in acceptable conditions. In addition, inspection of the cast iron fire hydrant body showed that cast iron materials perform well in direct buried application (Reference Passport Assignment 00330592.26.27).

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007 and the 2005 evaluations consistently rank underground portions of the Fire Protection System Lines with Low Risk.

7.7 Chlorine Injection Lines
These lines inject chlorinated water in relatively high concentrations into the Service Water, ESW and Circulating water. A leak in one of these lines could cause an unmonitored underground release of chlorine. In addition, the released of chlorine would attack the external coal tar coating on other underground piping. In 1993 during modification to one of these lines a hydrostatic test was performed on the portion of the line that is underground. The test showed no degradation of this line. However, the material condition of the Service Water and Circulating Water System injection lines is unknown at this time.

In 2005, actions had been issued to inspect these lines during the planned excavation to tie in the ESW and Service Bypass modification in 2006.

However the ESW and Service Water modification was deferred form 2006 to 2008 and therefore the chlorine line the inspections were also deferred until 2008. Unfortunately the 3" chlorine line to the Service Water System developed a leak in the summer of 2006 near the Startup Transforms. The line was abandoned and a temporary hose was installed in it place. The ESW and Service Water modification was then revised to include the replacement of all three chlorine lines (ECR 07-00458).

In 2008, all three chlorination lines to the ESW and Service Water System were replaced with double-wall pipe. The Risk Evaluation for these lines has been revised (Appendix 2, 4 and 5) and they are no longer considered Priority 1 "High Risk".

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007 and the 2005 evaluations consistently rank underground portions of the Chlorination System with High Risk. However, this evaluation did not considered the planned modification, which replaces these lines with double-walled pipe. Therefore, the database will require revision after the modification is complete in the next update.

8.0 Risk Ranking

8.1 Methodology

8.1.1 Data Collection

The list of systems developed in 1991 and the underground lines developed in 1997 (TDR 1218) was revaluated. Also lines identified with the potential to affect plant capacity or accident mitigation were added to the inventory. Each line was assigned a program identification number.

A review was then performed of each remaining underground line to determine the following information:

1) Description and function
2) Size
3) Pipe material
4) Length of piping underground
5) Fluid and Level of contamination
6) Coating/ Protection
7) Depth Underground
8) Reference Drawings
9) Recent inspections and Repairs
10) Additional Comments

Based on the above data each line was then assessed risk and consequence values per the criteria in section 8.1.2 through 8.1.4.

8.1.2 Susceptibility

In 1997 and 2005, each line was assigned a Low, Medium or High "Probability" value based on the known conditions of existing pipe material, coating systems, and plant experience. ER-AA-5400-1003, which was implemented at Oyster Creek in 2007, requires a "Susceptibility Ranking" for underground piping segments. Review of section 4.1.3 and attachments 4 and 6 of procedure ER-AA-5400-1003 indicates that the following methodology (which was been renamed Susceptibility Ranking) meets the requirements of the new procedure.

The following criteria were used as a guide.

Low Susceptibility

- Line carries salt water, is carbon steel with internal coat tar coating and has been inspected within the last 20 years.
- Line is direct buried aluminum has been inspected within the last 10 years.
- Line is directed buried carbon steel with external coal tar coating and has been inspected within the last 30 years.

- Line is aluminum has been replaced within the last 15 years.
- Length of piping in vault or underground less than 20 feet, or
- Leak can be quickly detected,

Medium Susceptibility
- Line carries salt water, is carbon steel with internal coal tar coating and has been inspected within the last 25 years.
- Line is direct buried aluminum has been inspected within the last 15 years.
- Line carries salt water, is carbon steel with internal coal tar coating and has been replaced within the last 35 years.
- Line is direct buried aluminum has been replaced within the last 20 years.
- Length of piping underground is more than 20' but less than 50',
- Leak cannot be quickly detected,
- Pipe wall material; Carbon Steel with Coal Tar Coating,
- Line is within an existing vault.

High Susceptibility
- Line has never been inspected or replaced,
- Length of piping underground is more 50',
- It would be difficult to detect a minor leak, or
- Material is aluminum.

8.1.3 Consequence

In 1997 and 2005 each line was assigned a High, Medium or Low Environmental Consequence value and a High, Medium or Low Operational value. ER-AA-5400-1003 requires a "Consequence Ranking" which combines Operational and Environmental Consequences into one factor.

This revision will no only apply one Consequence Ranking consistent with the new procedure.

The following criteria will be considered:

Low Consequence
- Contamination level in fluid is Low (i.e.- Domestic Water, Air, RBCCW water, Raw Service Water, etc.)
- Leak would be easy to identify, access and repair,
- Line can be placed out of service without major complication to Plant Operations,
- Access to repair is easy (excavation would less than 5' deep with no interference).

Medium Consequence

- Contamination Levels in fluid are Medium (i.e.- Condensate Transfer, Heating Steam and Condensate, Laundry drains, and Sumps)
- Leak would be harder to identify, access and repair,
- Repair would be timely and expensive,
- Leak may result in inability to transfer Clean-up sludge or Resin's thereby affecting outage windows or plant chemistry, or
- Access is more difficult (excavation is 5' to 8' deep with some inferences).

High Consequence

- Contamination Levels in fluid are High (i.e. Cleanup Filter Sludge, Cleanup Resins)
- Leak would be difficult to identify, access and repair,
- Leak will result in a Plant Trip,
- Leak may not be isolated and may result in a plant shutdown, or
- Access is difficult (excavation is greater than 8' deep with interference's).

8.1.4 Deleted

8.1.5 Systems Excluded

Below is a listing of systems not included in the evaluation and basis for exclusion:

1. Radwaste Service Water - This system has been concluded to be not a problem system. Reference TDR 1162
2. Fire Protection - This system has been concluded to be not a problem system. Reference TDR 1162
3. Fuel Oil - These lines were replaced in 2007 per ECR 04-00584.
4. N2 Tank- Leakage is not a radiological or immediate operational concern.
5. Hydrogen Injection - Leakage is not a radiological or immediate operational concern. This piping is cathodically protected and is encased with an external casing.

8.1.6 Risk Assessment Analysis

Further action for each line was then evaluated based on the following criteria for Susceptibility versus Consequence.

Review of section 4.1.5 of ER-AA-5400-1003 indicates that the following Analysis Methodology, which was established in 1997, meets the requirements of the procedure.

Risk Assessment	**High Consequence (3 points)**	**Medium Consequence (2 points)**	**Low Consequence (1 points)**
High Susceptibility (3 points)	Evaluate minimum expected service life and develop corrective action or inspect within operating cycle. (9 Points)	Evaluate minimum expected service life and develop corrective action or inspect within operating cycle. (6 Points)	Re-evaluate within five years. (3 Points)
Medium Susceptibility (2 points)	Evaluate minimum expected service life and develop corrective action or inspect within operating cycle. (6 Points)	Evaluate minimum expected service life and develop corrective action or inspect within operating cycle. (4 Points)	Re-evaluate within five years (2 Points)
Low Susceptibility (1 points)	Evaluate minimum expected service life and develop corrective action or inspect within operating cycle. (3 Points)	Re-evaluate within five years (2 Points)	Re-evaluate within five years (1 Point)

8.2 Risk Assessment Results

8.2.1 General Results

A great deal of the underground piping at Oyster Creek that contains contaminate fluids is contained in piping tunnels that are below grade. These tunnels begin on east wall of the Turbine Building, run north to the Reactor Building, then east along the south wall of the Reactor Building, to the base of the Stack, then to Old Radwaste along the west wall of the Reactor Building. Any leakage in from these lines would flow to the 1-12 sump in the base of the stack. Therefore, piping leaks in the piping tunnel represent low risk and low radiological consequence.

The majority of the risk and consequence significant direct buried underground lines at Oyster Creek lie either to the south of the Reactor Building or to the west of the Turbine building. See Appendix 6 for markups of plant underground drawings.

In the 1990's, Oyster Creek performed inspections and replaced portions of risk and consequence significant direct buried underground lines. These inspections are documented in the matrix in appendix 4.

8.2.2 High Susceptibility with High to Medium Consequence
Refer to appendix 4, 5, and 6.

8.2.2.1) Offgas Holdup Lines (CS-19 and CS-20)
Approximately 510 feet of 48" piping (CS-19) and 400 feet of 36" piping (CS-20) for the Offgas Holdup Lines located south of the Reactor Building between the Office Building and the Stack. These lines are carbon steel with coal tar internal and external coating. These lines have been determined to have a high risk of developing a leak due to the history at Oyster Creek in which underground carbon steel piping with coal tar coating has develop corrosion due to coating degradation. These lines were installed in 1968 and have never been inspected. Since the fluid in this piping is radioactive gas with some water vapor, leakage through the piping may contaminate the surrounding soil. On occasion during power operation these lines have filled with process water. A minor leak would probably not be observed. A major leak would most likely shutdown the plant due to an uncontrolled release path.

Significant degradation of these lines will most likely be due to external attack on the coating and external corrosion of the carbon steel pipe wall. Based on plant operating experience the coating has the potential service life of 15-40 years and the pipe wall has the potential life of 25 to 60 years. Therefore, assuming the coating was properly applied these lines have a minimum service life of 40 years. Therefore since these lines were last inspected in 1969 they should be inspected prior to 2009. During 2007 these lines were considered for inspection by using Guided Wave and "C" Scan Technologies.

Unfortunately, the "C" Scan technology does not seem to by a good application for these lines. The technology requires isolation of the line from equipment such as pump, valves that are throttled and Steam Jet Air Ejectors. Also the configuration of these the two lines, which run in close together in the soil, will cause signal interferences and cross talk.

However, Guided Wave scanning is possible if the inspections are performed from within excavation in the yard south of the Reactor Building for the following reasons.

1) The lines are too long for the signals to travel their entire length.

2) Both ends of the lines in the Turbine Building and in the Stack do no have accessible lengths of pipe in which a collar can be installed.
3) The radiation and contamination levels in the base of the stack would result in significant exposure to the inspectors.
4) The radiation and contamination levels in Steam Jet Air Ejector Room would result in significant exposure to the inspectors and to support personnel that would be required to build scaffolding. .
5) Since both lines contain a gas mixture, which could create acoustical interferences while in service, a system outage is necessary to perform the inspections. Please Note the actual inspection, once the collar is installed, takes minutes.

Given the above limitations, it has been decided that performing an approximately 16 foot deep excavation and allowing access to the lines about mid length is the best alternative.

The following strategy has been developed.

1) Excavate and expose the lines prior to 1R23. The excavation will require shoring.
2) During 1R23 while the lines are out of service remove enough coating so that the collars can be installed.
3) Perform the inspection.
4) Install permanent cables to the lines and run them to grade so that "C" Scan Inspections can be performed in the future without the need for excavations. (This is not an option for Guide Wave).
5) Recoat During 1R23
6) Backfill after 1R23

This project has been entered in to the Plant Health Committee (PHC) process and was originally proposed for the 1R22 Refueling Outage in 2008. However, the Plant Review Committee (PRC) tabled this project for 2008 and recommended implementation in 2010 during the 1R23 Outage. This project is tracked in the funding and work management systems as IR 00698332 and Profolio Directory Number 134307.

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007 segmented risk ranking evaluation did not rank these lines with high-risk ranking (none in the top 30 segments). However, actions are being pursued based on the 2005 evaluation. Future revisions of the data based should correct this discrepancy.

8.2.2.2 Condensate Transfer Line To Turbine Building (A-4)

An approximate 25' long portion of a 6" Condensate Transfer line (A-4) from the Condensate Transfer Pumps to the Turbine Building. This is the main Condensate

Transfer System supply line to the plant. Risk of this line developing a through wall leak is high.

Plant experience shows that direct buried aluminum lines have leaked many times at Oyster Creek. In the past 15 years Oyster Creek has replaced all but four of its direct buried aluminum lines with above ground pipe.

A search of the configuration management system records indicates that this line (CH-5, A4) is still an original line.

This line has a medium radiological and operating risk. A leak of this line would result in an unmonitored leak of contaminated water. Also a significant leak would challenge the plant's ability to makeup water to the Condensate System, the Isolation Condensers and various other plant systems.

It is not certain if this line was inspected during a 1993 activity in which the area was excavated. The excavation was performed to repair a leak on an adjacent line. Review of the underground drawings and photos taken at the time of the excavation indicates that this line should have been exposed. Therefore the assumption is made that the coating of this line was inspected and repaired as necessary in 1993. Therefore assuming a service life of 15 to 20 this line should be inspected within 15 years of the previous 1993 inspection (2008). No credit was applied for the pipe wall in the service life assessment in Appendix 4.

This line was inspected in 2007 using Guided Wave Technology, with acceptable results. Results are documented in reference 10.23.

In 2008, this line was then excavated and partially inspected (approximately 10 feet). The coating was found to be in very good condition. This inspection substantiated the Guided Wave Inspection performed in 2007. This inspection met a License Renewal commitment documented in Passport Assignment 00330592.27.26. This was the first inspection of the new coating installed on aluminum pipe. The Risk Evaluation for this line has been revised (Appendix 2, 4 and 5) and is no longer considered "High Risk".

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007 and the 2005 evaluations consistently rank this underground line as High Risk.

8.2.2.3) Condensate Transfer line To CRD System (A-1)

A 4-foot long portion of a 12" Condensate Transfer line (A1) from the CST to the Core Spray System and the CRD pumps. This aluminum line is located between the Turbine Building and the Reactor Building on the northwest corner of the Reactor Building and is inaccessible. In 1998, a project was performed to core bore the concrete slab above the gap in this area. A sample well was then installed under the condensate transfer line. The well showed that there was no moisture under the line. Soil samples showed no residual traces of tritium in the soil. However no coating and wall thickness measurements were possible.

The primary contributor the high corrosion rate of buried aluminum pipe at Oyster Creek is galvanic corrosion. The galvanic mechanism is due to the interaction between the aluminum pipe wall and the large copper-grounding grid located on the west side of the plant. The grounding grid protects the main transformers and other electrical equipment and lies in the same footprint as the majority of the direct buried aluminum pipe; before it was replaced by above ground pipe. The dissimilar metals and moisture in the soil result in a high electrical/chemical potential that drives the galvanic corrosion. Corrosion occurs in moist areas where the external coating was not properly applied or has broken down.

However, this line is not located near the grounding grid or any other cooper materials and the soil is dry. The technical literature indicates that corrosion rate for aluminum in dry soil is at least half magnitude of corrosion rates in wet soil (reference 8.10).

This line was assessed a medium consequence value since it supplies condensate to the CRD Pumps. Also a leak of this line would result in an unmonitored release.

The 1998, inspection did not inspect coating or pipe wall. It simply tested for leakage in the soil under the line. Since a pipe leak was not found in 1998 it was concluded that coating was properly applied and credit was taken for the coating service life.

Significant degradation of these lines will most likely be due to external attack on the coating and external corrosion of the carbon steel pipe wall in dry soil. Based on plant experience and technical references the coating has the potential service life of 15-40 years and the pipe wall has a potential life of 25 to 50 years, based on dry soil. Therefore assuming the coating was properly applied and a galvanic corrosion mechanism does not exist, this line has a minimum service life of 40 years. Therefore this line should be inspected by 2009.

In 2007, this line was inspected using Guided Wave Technology. The inspection showed that this line wall had no wall loss. Therefore, as of 2007, this line is acceptable. Follow up inspection should be within five years.

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007 and the 2005 evaluations consistently rank this underground line as High Risk.

8.2.2.4) Radwaste Lines To Pipe Tunnel (CS-6, CS-7, and CS-8)
Three carbon steel lines: a 2" Laundry Drain line (CS-6), a 3" Reactor Building Sump line (CS-7), and a 2" DWEDT line (CS-8). These lines run from the Reactor Building to the Pipe Tunnel in the southeast vault. These lines were inspected and repaired as necessary in 1993. These lines were once again inspected during 2001 and found with no coating degradation. They were again inspected in 2004 and coating degradation was observed. CAP O2004-2071 was issued to document the problem. Pipe wall thickness inspection of these lines confirmed that wall thickness was acceptable (reference O2004 2071). The external coating was then repaired. Based on this experience, the risk of a

coating breakdown is ranked high. Since these lines carry contaminated water the consequences of a leak is considered medium.

The pipe in the southeast vault is located 10 to 12 feet below grade, which is below the water table. Therefore, these lines are submersed in ground water. In addition two of these lines operate at elevated temperature. Since the coating on these lines was acceptable in 2001 and not acceptable in 2004 no credit can be taken for coating service life. As part of the CAP Corrective Action the System manager has recommended establishing a PM to drain the southeast vault every two years and inspect these lines.

Based on plant experience, pipe wall on these lines has a potential life of at least 5 years. Therefore these lines should be inspected every two years.

In 2007 an attempt was made to inspect this line using Guided Wave Technology from in side the pipe tunnel. Unfortunately the Guided Wave collar could not be placed on the lines due to interferences (see IR 00686711). A new project has been submitted for 2008 where these lines will be inspected from the Reactor Building side (PD 122655).

In 2008 the coating on these three lines was inspected as part of a new PM (PM PM57304M). This PM opens and drains water out of the vault. This PM was developed to support License Renewal Commitments (Passport assignment 00330592.26.20). The inspection found that the coating on these three lines had broken down and required repair. An IR was issued to document this condition. The IR (00813967) was accompanied by an evaluation, which concluded that the coating conditions did not pose an immediate operability concern. Repairs are planned per work order R2130898.

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007 and the 2005 evaluations consistently rank these underground lines as High Risk.

8.2.3 Medium and Low Susceptibility and High Consequence

8.2.3.1) Reactor Cleanup Sludge Transfer Line (CS-1)

A 1" carbon steel Reactor Cleanup Sludge Transfer line (CS-1) to Radwaste. This line is located approximately five to six feet below grade in the central vault south of the Reactor Building and is therefore not in direct contact with soil. Although this line was inspected in 1997 and repaired, the inspection was only an external visual inspection. Since this line transfers highly contaminated RWCU filter sludge, the consequences of a leak would be severe due to the high contamination levels of the sludge.

This line is not expected to be submerged in ground water, as is the case of piping in the southeast vault. The piping in the central vault is located approximately four to six feet from grade, which is above the water table. While the pipe in the southeast vault is located 10 to 12 feet below grade, which is below the water table.

Degradation of this line would most likely be due to degradation of the coating and external corrosion of the carbon steel pipe wall. Based on plant operating experience the coating has the minimum service life of 15 years. No credit will be taken for the pipe wall since UT measurements were not performed in 1997. Therefore this line should be inspected within 15 years of the last inspection (2012).

In 2007, this line was considered for Guide Wave Inspection. Unfortunately, the technology cannot inspect lines that are 1 inch in diameter or smaller. In addition, this line is too short for "C Scan" Technology.

Therefore, a project to replace this line should be considered for funding 2010 for installation in 2012.

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007 and the 2005 evaluations consistently rank this underground line as High Risk.

8.2.3.2) Reactor Cleanup Lines (SS-1 and SS-2)
Two 3" stainless steel Reactor Cleanup lines. These lines are direct buried south of the Reactor Building, between the RB and Pipe Tunnel. These lines were inspected in 1993. The lines were then backfilled and are no longer accessible. Since these lines transfer contaminated RWCU Demin. Resins, and Condensate, a leak would result in an unmonitored release of contaminated fluid.

Degradation of these lines will most likely be due to degradation of the coating and external corrosion of the stainless steel pipe wall. Based on plant operating experience the coating has the potential service life of 15 to 40 years and the pipe wall has the potential life of 15 to 30 years. Therefore this line should be excavated and inspected within 30 years of the last inspection (2023). These lines are not submerged in ground water.

In 2007, an attempt was made to inspect this line using Guided Wave Technology from in side the pipe tunnel. Unfortunately the Guided Wave collar could not be placed on the lines due to interferences. A new project has been submitted for 2010 where these lines will be inspected from the Reactor Building side.

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007 and the 2005 evaluations consistently rank this underground line as High Risk.

8.2.3.3) Air and Containment Spray Lines in SE Vault (CS-9, CS-10, and CS-11)
Three carbon steel lines: a 4" Instrument Air line (CS-10), a 4" Instrument Air line 2" (CS-11), and a 14" Containment Spray line (CS-9). These lines run from the Reactor Building to the Pipe Tunnel in the southeast a vault. These lines were inspected and repaired as necessary in 1993. UT inspection in 1993 showed the pipe wall was acceptable. These lines were once again inspected during 2001 and 2004 and the external coating was found to be acceptable. The pipe in the southeast vault is located 10 to 12 feet below grade, which is below the water table. However 2001 and 2004 inspections show that the coating has stood up fairly well since 1993.

Should the Instrument Air line develop a significant leak, the plant would probably trip due to loss of instrument air. Also a leak on the Containment Spray line could place the plant in an LCO. Therefore these lines were assessed a high consequence value.

Based on plant operating experience the coating has the potential service life of at least 10 years and the pipe wall has the potential life of 8 to 30 years. Therefore this line should be inspected within 18 years from of the last inspection. However since these lines are located in the same southeast vault as CS-6, CS-7, and CS-8, which have a much shorter expected service life (see section 8.2.2.4) they will be inspected at a greater frequency.

In 2007 these lines were inspected using Guided Wave Technology. The inspection showed that the line pipe wall was in acceptable condition. Therefore as of 2007 this line is acceptable. Follow up inspection shall be within 5 years.

In 2008 the coating on these three lines was inspected as part of a new PM (PM PM57304M). This PM opens the vault and drains water out of the vault. This PM was developed to support License Renewal Commitments (Passport assignment 00330592.26.20). The inspection found that the coating on the two airlines had broken down and required repair. An IR (00813967) was issued to document this condition. The IR was accompanied by an evaluation, which concluded that the coating conditions did not pose an immediate operability concern.

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007 and the 2005 evaluations consistently rank these underground lines as High Risk.

8.2.3.4) Control Air Line to Intake and Condensate Transfer Building (CS-37)
An approximately 600' long 1 ½" and 2" brass Instrument Air line that runs from the southwest corner of the Turbine Building to the Condensate Transfer Building and to the Intake. Except for a small portion near the intake road this line has never been inspected. The small portion (less then 7 feet) near the intake road was inspected during a 2004 excavation. The excavation was performed to tie-in the new ESW and Service water System underground piping. The inspection of the line was only external and did not perform thickness testing.

The technical literature indicates that corrosion rates of brass in soils are relatively low (i.e. 1 to 5 mpy (references 10.20 and 10.21). Based on plant operating experience the coating has the potential service life of 15 to 40 years and the pipe wall has the potential life of 25 to 60 years. Therefore this line should be inspected or tested within 40 years of the installation (2009). A significant leak on this line could result in a plant trip. Therefore the operating consequence is rated high.

In 2007, an attempt was made to inspect this line using Guided Wave Technology from in side the Chlorination Building. Unfortunately this line is 1 ½" at this location and the vendor currently does not have a collar which fits pipe of this size.

In 2008, a spare line was laid across the northwest intake road during the modification which replaced the chlorination lines (reference ECR 07-00459). Since the most costly part of running a new small bore line from the Chlorination Building to the Intake is getting across the north to south intake road, it was decided to run a spare line for the air system. In the future a modification could be pursued to replace the remainder of the line by 2010. IR has been submitted to pursue a modification.

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007, segmented risk ranking evaluation did not rank this line with high-risk ranking (none in the top 30 segments). However, action are being pursued based on the 2005 evaluation. Future revisions of the data based should corrective this discrepancy.

8.2.3.5) Condensate Transfer Line to Reactor Building (A-2)
A 10-foot long portion of a 6" Condensate Transfer line from the Pipe Tunnel to the Reactor Building at the southwest corner of the Reactor Building. This is the main Condensate Transfer System line to the Reactor Building. In 1980 this line was excavated, inspected and repaired. Records indicate the coating was repaired. A vault was then built around the line.

The primary contributor for the high corrosion rate of buried aluminum pipe at Oyster Creek is galvanic corrosion. The galvanic mechanism is due to the aluminum pipe wall and the large copper-grounding grid located on the west side of the plant. However this line is not located near the ground grid and is no longer direct buried. Therefore the same corrosion mechanism may not be applicable. Since this line is located 4 feet from grade, it is not submerged in ground water.

This line was assessed a medium consequence value since it supplies condensate to the Reactor Building including the Isolation Condensers. Also a leak of this line would result in an unmonitored release. Therefore this line was assessed a medium radiological consequence.

Degradation of this line will most likely be due to degradation of the coating and external corrosion of the aluminum pipe wall. Based on plant operating experience the coating has the potential service life of 15 to 40 years and based on dry soil, the pipe wall has the potential life of 20 to 40 years. Therefore this line should be excavated and inspected within 35 years of the last inspection (2015).

In 2007 an attempt was made to inspect this line using Guided Wave Technology from in side the Pipe Tunnel. Unfortunately the GW collar could not be placed on the lines due to interferences (IR 00686711). A new project has been submitted for 2010 where these lines will be inspected from the Reactor Building side (PD 122655).

Reconciliation Between 2007 Segmented Risk Rank and 2005 Risk Rank
The 2007 and the 2005 evaluation both consistently rank these underground lines with High Risk.

8.2.4 Medium Susceptibility and Medium Consequence

8.2.4.1) Radwaste Line to Pipe tunnel (CS-2, CS-3, CS-4, and CS-5)

Four lines located in the central vault south of the Reactor Building. These are: the Cleanup High Purity Transfer line to Radwaste, the Fuel Pool Cooling Transfer Line to Radwaste, the Cleanup System High Purity Transfer line to the Condensate System, and the RBEDT drain line to Radwaste.

In 1997 the 6" Fuel Pool Cooling line (NN-3, A-3) developed a leak. An excavation was performed to replace this line. The excavation exposed these four lines. Therefore these lines were inspected and the coating repaired. A vault was then built around these lines. Therefore they are no longer direct buried. Also since these lines are located between 5 and 6 feet from they do experience ground water submergence.

Degradation of these lines will most likely be due to degradation of the coating and external corrosion of the carbon steel pipe wall. Based on plant operating experience the coating has the potential service life of 15 to 40 years and the pipe wall has the potential life of 6 to 25 years. Therefore these lines should be inspected within 21 years of the last inspection (2018).

In 2007 an attempt was made to inspect this line using Guided Wave Technology from in side the pipe tunnel. Unfortunately the GW collar could not be placed on the lines due to interferences . A new project has been submitted for 2010 where these lines will be inspected from the Reactor Building side (PD Number 122655).

8.2.4.2) RBCCW Lines (CS-17 and CS-18)

Two 8" carbon steel lines are direct buried between the south side of the Reactor Building and the Pipe Tunnel. These lines are RBCCW lines that run to Old Radwaste. The equipment that these lines cool have long been abandoned. The lines were cut and capped in Old Radwaste. However, the portions of these lines that are direct buried and in the Pipe Tunnel are still pressurized. Therefore a leak would result in a loss of inventory in the RBCCW System and a significant leak could trip the plant.

These lines were assessed as a medium risk factor since they are direct buried carbon steel lines. These lines were assessed a medium factor since a leak could lead to a plant shutdown.

Degradation of these lines will most likely be due to degradation of the coating and external corrosion of the carbon steel pipe wall. Based on plant operating experience the coating has the potential service life of 15 to 40 years. Therefore these lines have a minimum service life of 15 years. No credit was taken for the pipe wall. Since these lines were inspected (coating only) in 1993 they should be abandoned by 2010.

In 2007 an attempt was made to inspect this line using Guided Wave Technology from in side the pipe tunnel. Unfortunately the GW collar could not be placed on the lines due to interferences. A new project has been submitted for 2010 where these lines will be inspected from the Reactor Building side (PD Number 122655).

8.2.4.3) AOG Lines (CS-22, CS-23 and CS-30)

Three Offgas lines are direct buried between the AOG Building and the Stack. These lines are AOG Offgas supply and return lines and the AOG Building sump Drain line and were installed in the early mid 1980's.

These lines were assessed as a medium risk factor since they are direct buried and have not been inspected since installation in the mid 1980's. These lines were assessed a medium Radiological factor, since a leak could lead to an unmonitored release.

Degradation of these lines will most likely be due to degradation of the coating and external corrosion of the carbon steel pipe wall. Based on plant operating experience the coating has the potential service life of 15 to 40 years and the pipe wall has the potential life of 10 to 40 years. Therefore assuming the coating was properly applied these lines have the service life of a minimum of 25 years. Therefore, these lines should be inspected or pressure tested.

In 2007, an attempt was made to inspect this line using Guided Wave Technology from an excavation near the Main Fuel Oil Tank. Unfortunately the excavation could not be performed in time to support the inspection scheduled. A new project has been submitted for 2009 where these lines will be inspected (PD Number 122655).

8.2.4.4) Condensate Transfer Line to Turbine Building (CS-24)

A 10" carbon steel line is direct buried between the Condensate Building and the Turbine Building. This line supplies flow from the Hot Level Control System in the Condensate Building to the Hotwell.

This line was assessed as a Medium Risk factor since it is direct buried carbon steel line. This line was assessed a medium Radiological Consequence factor since a leak could lead to an unmonitored release and a Medium Consequence factor since a significant leak could lead to a plant shutdown.

Degradation of this line will most likely be due to degradation of the coating and external corrosion of the carbon steel pipe wall. Based on plant operating experience the coating has the potential service life of 15 to 40 years and the pipe wall has the potential life of

12 to 50 years. Therefore, these lines should have a minimum service life of 27 years. Since this line was inspected in 1993 it should be inspected or pressure tested by 2020.

In 2007, an attempt was made to inspect this line using Guided Wave Technology from inside the Condensate Building. Unfortunately the inspection was not successful due to high acoustic signals created by the hotwell level control valves in the Condensate Building. A new project has been submitted for 2010 where these lines will be inspected from inside the Turbine Building during 1R23 (PD Number 122655).

8.2.4.5 Condensate Pump Startup Seal Water Line and CST Return Line (CS-26 and CS-38)

These are two carbon steel 1-inch lines, which run from the Turbine Building to either the Condensate Building or to the CST. One line is direct buried between the Condensate Building and the Turbine Building (CS-26) and supplies flow from the Hotwell Level Control System to the Condensate Pump Seals, only during plant startup and shutdown. The other Line runs from the Northeast Corner of the Turbine Building to the CST (CS-38) and provides minimum recirculation flow from the CRD Pumps.

These lines were assessed as a medium risk factor since they are direct buried and could result in an unmonitored radiological leak and possibly lead to a plant shutdown.

Degradation of these lines will most likely be due to degradation of the coating and external corrosion of the carbon steel pipe wall. Based on plant operating experience the coating has the potential service life of 15 to 40 years and the pipe wall has the potential life of 4 to 15 years. Therefore these lines should have a minimum service life of 19 years. Since these line were inspected in 1993 they should be re-inspected, pressure tested or replaced by 2012.

In 2007, these lines were considered for Guide Wave Inspection. Unfortunately the technology cannot inspect lines that are 1 inch in diameter or smaller. In addition these lines are too short for "C Scan" Technology.

Therefore, a project to replace these lines will be pursued for funding in 2009 for and installation in 2010. An IR has been submitted to pursue modification of these lines.

8.2.4.6 Chlorination Lines CS-35

Three 3" carbon steel lines are direct buried between the Condensate Building and the intake. These lines supply chlorination water to the Service Water and the ESW Systems. These lines are internally coated with a plastic liner and externally coated with coal tar.

These lines were assessed as a medium risk factor since they are direct buried carbon steel lines. These lines were assessed a medium consequence factor since a leak could result in an unmonitored release for chlorine.

Degradation of these lines will most likely be due to degradation of the external coating and external corrosion of the carbon steel pipe wall. Based on plant operating experience the coating has the potential service life of 15 to 40 years and the pipe wall has the potential life of 8 to 30 years. Therefore these lines should have a minimum service life of 23 years. Since these lines were installed in the mid 1980's the 2005 assessment of these lines concluded that they should have been inspected by 2006. An opportunity had been planned to inspect these lines during the planned modification to the ESW and Service Water System in 2006. Unfortunately in 2006 the modification was deferred until 2008, which also deferred the inspection.

In 2006, the Chlorine Line to the Service Water System leaked at a location that was below under the Chlorination Building (IR A2144398). The leakage caused a large "sink hole" on the south side of the Chlorination Building near the north Startup Transformer. The leak was terminated about 12 hours later by slipping a pancake flange between two flanges. The line was then abandoned and was temporarily replaced by a hose (reference the TCCP 06-00506).

As a result of this 2006 leak, the scope of the existing project to replace underground ESW and Service Water line was increased to also replace the three Chlorination Lines (ECR 07-00459). Completion was scheduled for 2008.

In 2008, all three chlorination lines to the ESW and Service Water System were replaced with double-wall pipe. The Risk Evaluation for these lines has been revised (Appendix 2, 4 and 5) and they are no longer considered Priority 1 "High Risk".

8.2.4.7 Torus to TWST Transfer Line CS-31

This line is a 4" Carbon Steel Line that was originally used to transfer water from the Torus to the Torus Water Storage Tank (TWST). This line may be used in future outages to transfer water from Torus to the TWST during Torus coating inspections and repairs. In the past this line was occasionally used to transfer radwaste water to the TWST. Therefore the internal wall of the line is considered contaminated. The material condition of this line is not known.

This line was assessed as a medium risk factor since it is a direct buried carbon steel line with a medium Consequence factor since a leak could result in an unmonitored release of contaminated water.

Degradation of this line will most likely be due to degradation of the external coating and external corrosion of the carbon steel pipe wall. Based on plant operating experience the coating has the potential service life of 15 to 40 years and the pipe wall has the potential life of 8 to 30 years. Therefore, these lines should have a minimum service life of 23 years. Since these lines were installed in the mid 1980's lines should be inspected by 2008.

Approximately 70 to 90 feet of this line from the TWST Tank was inspected using Guided Wave Technology in 2007. Results showed 40% to 70 % wall loss in large sections of the inspected pipe. Therefore per the directions of corporate procedure ER-AA-5400 this line shall no longer be used for service. IR 00709720 was issued to document the material condition of this line and to recommend flushing this line and abandonment.

During a separate modification to install a dedicated demineralized water tank for the Isolation Condensers in 2008, this line was excavated and found to be in the footprint of the new tank. Therefore, approximately 60 feet of this line was removed.

8.2.4.8 Heating Steam Line Leak in 2007

In 2007, per WO C2016333 an excavation exposed about 6 to 8 feet of the underground 8" Reactor Building Boiler Steam Supply Line located just south of Reactor Building. This excavation was performed because the line has a steam leak in the Pipe Tunnel penetration. The excavation was necessary to expose the outside of the penetration so that the location of the leak could be identified and the line inside the penetration could be replaced.

The general condition of the exposed 8" line was that the external coating has completely broken down which has allowed soil to contact the carbon steel pipe wall. The exposed pipe wall showed signs of general corrosion. UT inspections were performed in four separate areas. The UT inspections found pipe wall thicknesses that varied between 0.08 inches and 0.2 inches. The original pipe wall was 0.322 inches.

Corrective action was to excavate and replace the entire line. This underground portion of this line is only about 10 to 12 feet long. About 6 to 8 feet have already been excavated. The replacement included an improved coating system for the elevated temperatures of this steam line.

9.0 Corrective Actions

9.1 Program Actions

Actions 9.1.1 and 9.1.2 are complete and have been deleted.

9.1.3) Three Offgas lines which are direct buried between the AOG Building and the Stack should be inspected before December 2010. These lines are direct buried within 5 feet of grade and may be inspected online.

IR 00696852 and PD 122655 have been issued to obtain funding approval in 2009.

9.1.4) Three 3" carbon steel Chlorination lines that are direct buried between the Condensate Building and the Intake Structure will be replaced per ECR 07-00459. This project is scheduled for complete in 2008.
Status: COMPLETE

9.1.5) Two 500 foot long 36" and 48" Offgas Holdup Lines (AE-1, CS-19; AE-1, CS-19) should be inspected before December 2010. These lines have not been inspected since installation in the early 1969 and have been assessed with high risk and medium consequence and high consequence. These lines have an expected minimum service life of 40 years.

IR 00698332 and PD 134307 have been issued to obtain funding approval in 2010.
Status: Delayed by 2 years

9.1.6) An approximate 25' long portion of a 6" Condensate Transfer line (CH-5, A4) should be inspected before December 2008. This is a direct buried aluminum line that is the main Condensate Transfer System supply line to the plant that is with 5 feet below grade. **(CM-1)**
Status: COMPLETE

AR A2116126 was performed in 2008.

Risk of this line developing a through wall leak is high and the radiological and consequences are medium. Plant experience shows that direct buried aluminum lines have leaked many times at Oyster Creek. In the past 15 years Oyster Creek has replaced all but four of its direct buried aluminum lines with above ground pipe. Past experience indicates that the service life of direct buried aluminum lines is 15 to 20 years. This line was last inspected in 1993 and has an expected minimum service life of 15 years, which will be exceeded in 2008.

The inspection of this line is a License Renewal commitment (reference Passport Item 00330592-26-26)

Line CS-26 should be inspected at the same time due to its proximity to line A-4. This is a 1" carbon steel direct buried line that runs between the condensate Building and the Turbine Building.

This line was assessed as a medium risk factor and a medium factor. The project service life of this line was until 2012. .

9.1.7) Two 8" carbon steel lines are direct buried between the south side of the Reactor Building and the Pipe Tunnel (CC-4 CS-17, CC-3, CS-18) and should be modified before December 2010. These lines have been assessed with medium risk and medium operation consequence.

These lines are RBCCW lines that run to Old Radwaste. The equipment that these lines cool have long been abandoned. The lines were cut and capped in Old Radwaste. However, the portions of these lines that are direct buried and in the Pipe Tunnel are still pressurized. Therefore, a leak would result in a loss of inventory in the RBCCW System and a significant leak could trip the plant. A2018689 Eval 05 has been issued for Engineering to sponsor this modification to PHC in 2008 for implementation in 2010.

Status: On Track

9.1.8) A 1 ½" and 2" brass steel line is direct buried between the Turbine Building and the Condensate Transfer Building and the Intake (CA-2, CS-37). These lines should be pressure tested before December 2010. This line has been assessed with low risk and high consequence. IR 00861654 has been issued to sponsor a modification or a pressure test on this line.

Status: On Track

9.1.10) An approximate 400' long section of a 4" Torus to TWST Transfer line (CH-31) should be pressure tested before December 2008. In addition this line should be tested prior to each time it is used. This is a direct buried carbon steel line that contains contaminated water and is within 5 feet of grade. Guided Wave Inspection in 2007 has shown that this pipe is significantly degraded.

IR 00709720 has been issued to abandon this line.
Status: COMPLETE

9.1.11) Guided Wave inspections were planned for 2009 approximately 20 lines. (Reference PD 122655)

IR 00696852 and PD 122655 have been issued to obtain funding approval in 2008. PRC decided that these lines should be inspected in 2010.

Status: Delayed by 2 years

9.1.12) A Cathodic Protection assessment is being performed of the Oyster Creek Site. The goal of the assessment is to understand what the cost would be to install cathodic protection on important underground piping. The results of the assessment will be used to determine if it makes economic sense to pursue a wholesale installation of cathodic protection system. The results of the assessment are expected in the first quarter of 2009.

This work is being tracked by passport item 00625121

Status: On Track

9.1.13) Five underground lines with high risk are 1" in diameter. These lines cannot be inspected using Guided Wave or "C Scan" Technology. Given that these lines will be expected to be in service for up to 60 years it has been decided to pursue replacing these lines with aboveground lines.

IRs 00861654, 00861649 and 00861645have been issued to obtain funding approval.

Status: On Track

9.1.14) Upon entering the period of extended operation, focused inspection of buried piping and components will be performed within ten years, unless an opportunistic inspection occurs within this ten-year period. The inspections will include at least one carbon steel, one aluminum and one cast iron pipe or component. In addition, for each of these materials, the locations selected for inspection will include at least one location where the pipe or component has not been previously replaced or recoated, if any such locations remain. The stainless steel piping in the vault will continue to be periodically inspected, and the bronze material is addressed by the buried carbon steel pipe coating inspections **(CM-1).** Repetitive tasks PM53216M, PM42419M, and PM81501M have been developed and are schedule for these inspections

10.0 References

10.1 TDR 1162, Rev. 0 "OC Plant Optimization and License Renewal (POLR)".

10.2 TDR 1178, Rev. 0 "Service Water System Underground Piping Decision Analysis"

10.3 TDR 1179, Rev. 0 "Emergency Service Water System Underground Piping Decision Analysis"

10.4 B&R Drawings B&R 2192 through 2196, Composite Yard Drawings

10.5 SP-1302-12-261, Service Water (SW-1) and Emergency Service Water (SW-2) Inspection Program.

10.6 SP-1302-12-268, "Underground Piping Inspections"

10.7 OCMM-323721-001, "Spent Fuel Cooling Piping Relocation Reactor Building South Wall Elevation 18', 11"

10.8 Drawing, 3E-SK-M-049, Site Composite, Underground Facilities"

10.9 Oyster Creek Startup and Test Results Tracking Form – MTX NO. 104.13.1.6

10.10 TDR 1032, Rev. 1, "The Identification of Potentially Radioactive Systems"

10.11 TDR 1218 Rev. 0, "Evaluation of Oyster Creek Underground Piping Which Contain Contaminated Fluids"

10.12 Oyster Creek Procedure 341 "Emergency Diesel Generators"

10.13 GPUN Process plan 1000-PLN-7340.00, "Project Approval and Management Process"

10.14 Budget Activity 402972

10.15 Budget Activity 328376

10.16 Topical Report 140, Revision 2 "Emergency Service Water and Service Water System Piping Plan"

10.17 Operability Evaluation OC-2003-E-0013,

10.18 B&R Drawings B&R 2192 through 2196, Composite Yard Drawings

10.19 TDR 1032, Rev. 1, "The Identification of Potentially Radioactive Systems"

10.20 The Corrosion Handbook edit by UHLIG, John Wiley and Sons Inc., C 1948

10.21 Corrosion Control in Soils, by Samuel A. Bradford, Casti Publishing C 2001

10.22 ER-AA-5400, " Buried Piping and Raw Water Corrosion Program (BPRWCP) Guide"

10.23 Altran Solutions Report 07-0807-TR-002 Revision 0, Buried Piping Systems Susceptibility Analysis Document", Dated July 2007

10.24 STI Report (Guided Wave)

10.25 ER-AA-5400-1002, Rev 000, BURIED PIPING EXAMINATION GUIDE

10.26 Passport Assignment 00330952.26 – Buried Piping Program Commitments

10.27 Station Commitment (Action Tracking Item) AR 00330592.26, License Renewal Aging Management (section 1.0, section 9.0, Corrective Action 10; Appendix(s) 2 and 3) **(CM-1)**

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Appendix 1 – Significant Underground Pipe leaks

Item	Year	System/ Line	Material/Coating	Root Cause	Comments/ Section in Report
1	1980	Underground 6" & 10" Condensate Transfer lines	Al Original Aluminum piping exterior coating was Coal Tar	Pitting Corrosion/ Galvanic	During the repair of these lines it was found that all the Condensate and Demin. Water underground piping in the vicinity of the CST and Condensate Transfer Building had severe pitting corrosion. As a result a significant modification was performed which completely replaced all underground aluminum piping on these two systems in 1980. The modification added cathodic protection in the area to attempt to solve the galvanic corrosion mechanism (section 6.1).
2	1980	Underground 4" & 6" Demin Transfer Lines	Al Original Aluminum piping exterior coating was Coal Tar	Pitting Corrosion/ Galvanic	See note above
3	1985	ESW, Coating failures	CS/ Coal Tar	Pitting Corrosion/ Galvanic	See section 6.3
4	1986	Underground 2" Emergency Diesel Generator Fuel Oil line	CS/ Coal Tar		See section 7.4
5	1989	Underground 3" Aux. Steam and Condensate line	CS Coal Tar		
6	1991	Underground 2" Demin. Water, Augmented Off Gas line, and Auxiliary Steam lines"	AL Exterior surfaces coated with liquid primer and protective tape; with magnesium anode Cathodic protection	Pitting Corrosion/ Galvanic	See section 6.1

Appendix 1 – Significant Underground Pipe leaks

Item	Year	System/ Line	Material/Coating	Root Cause	Comments/ Section in Report
7	1991	Underground Condensate Transfer Lines 1" and 8"	CS/ Coal Tar		
8	1991	Underground 10" Condensate Transfer Line	AL Exterior surfaces coated with liquid primer and protective tape; with magnesium anode Cathodic protection	Pitting Corrosion/ Galvanic	This line was replaced in 1980. See items #1 and # 2 above
9	1992	Underground 1 " Domestic Water Line	CS		See Section 6.1
10	1992	20" Service Water Line- Just south of the Condensate Transfer Building	CS/Coal Tar		Degradation of the piping external coating- may have been due to improper original coating application
11	1993	Underground 4" Demin Water Transfer Line	AL Exterior surfaces coated with liquid primer and protective tape; with magnesium anode Cathodic protection	Pitting Corrosion/ Galvanic	This line was replaced in 1980. See items #1 and # 2 above. Section 6.1
12	1994	Underground 6" Condensate Transfer Line	AL Exterior surfaces coated with liquid primer and protective tape; with magnesium anode Cathodic protection	Pitting Corrosion/ Galvanic	This line was replaced in 1980. See items #1 and # 2 above. See section 6.1
13	1994	Underground 20" Service Water Line Northwest of the Turbine Building (Tee installed in 1987)	CS/ Coal Tar	Improper application of Internal Coating.	See Section 6.2

Appendix 1 – Significant Underground Pipe leaks

Item	Year	System/ Line	Material/Coating	Root Cause	Comments/ Section in Report
14	1994	Underground 30" Overboard Discharge Line near the discharge canal.	CS/ Coal Tar	Degradation of internal coating due to flow impingement downstream of an elbow.	See Section 6.2
15	1995	78" #4 Circ. Water Pump Discharge Line – Above ground	CS/ Coal Tar	Degradation of internal coal tar coating	See Section 6.2
16	1995	Two leaks on 24" Service Water and Circ. Water System Lines – Inside the Turbine Building	CS/ Coal Tar	Degradation of internal coal tar coating – Possibly due to flow impingement.	See Section 6.2
17	1996	4" SW supply to the Service water line – off the 20" Service Water Line	CS/ Coal Tar	Unknown	See Section 6.2
18	1999	30" Overboard Discharge Line Leak Near Seal Well	CS/ Coal Tar	Degradation of internal coal tar coating –Due to flow impingement.	See Section 6.2.2 and OC-MD-H496-001
19	2001	ESW System 2	CS/ Coal Tar	Degradation or improper application in internal coating at a branch connection.	See Section 6.2.1
20	2004	SW South of Condensate Building	Devoe 235 and 238 Coating System	Improper application in internal coating (no sand blasting) of Devote coating in 1996.	See CAP O2004-3331
21	2006	Chlorination Line South of Condensate Transfer Line	Carbon Steel. Plastic lined inside and Epoxy coating outside.	Unknown – Line was abandoned with excavation	See AR A2144398

Appendix 1 – Significant Underground Pipe leaks

Item	Year	System/ Line	Material/Coating	Root Cause	Comments/ Section in Report
22	2007	Heating Steam Line	8" Line south of Reactor Building.	External Corrosion	IR 00699131 See 8.2.4.8
21	2008	Service Water System Line At the Intake Road.	CS/ Coal Tar	Coating Breakdown	Line has since been Replaced

Appendix 2 –Program Systems, Priorities and Basis			
System	**Priority**	**Reference**	**Basis / Program Description**
ESW	2	TP 140/ PD 102153	100% of all buried Safety Related underground lines were replaced in 2008
Diesel Fuel Oil	3	PD 102026	These lines were replaced in 2006 with double wall pipe. Priority of the lines was changed from 1 to 3 in 2007.
Service Water	1	TP 140 / Line Item 121275	The majority of direct buried underground lines will be rehabilitated by 2010
Fire Protection	2	TR 116 Section 7.5	Inspections show no on going degradation mechanisms
Turbine Oil	1	TR 116 Section 7.6	Tested before each use. Guided wave Inspection shows no degradation
Condensate Transfer	1	TR 116 Section 8.2	Bulk of the system has been relocated above ground a with remaining underground lines in inspection program
Chlorination Lines	2	TR 116 Section 8.2	Replaced in 2008
Overboard Discharge	3	OC-MM-H496-001	Rehabilitated with Cure In Place Pipe in 2000 (priority change from 1 to 3 in 2000)
Off-Gas Holdup Lines	1	TR 116 Section 8.2	Partial inspection by 2010
Service Air	2	TR 116 Section 8.2	Coating inspection every two years
Instrument Air	2	TR 116 Section 8.2	Partial inspection by 2009.
Demineralized Water Transfer	3	TR 116 Section 8.2	Bulk of the system has been relocated above ground, with remaining underground lines in inspection program.
Heating Steam	2	TR 116 Section 8.2	Inspections are in the program (see section 8.2) Replacement??
Torus Water Transfer	2		– Abandoned in placed (IR 00709720) See 8.2.4.7
Hydrogen	3		Run To Failure
Nitrogen	3		Run To Failure
Old Radwaste Piping	2	TR 116 Section 8.2	Inspections are in the program
New Radwaste Service Water	2	TR 116 Section 8.2	Inspections are in the program
AOG	2	TR 116 Section 8.2	Inspections are in the program
AOG Drains	2	TR 116 Section 8.2	Inspections are in the program
Domestic Water	3		Run To Failure
Gas Station	3		Run To Failure – all lines have be relocated above ground
RBCCW	2	TR 116 Section 8.2	Modify by 2010 Inspection IST
Cleanup Demineralizer	2	TR 116 Section 8.2	Inspections are in the program

Appendix 2 –Program Systems, Priorities and Basis			
System	**Priority**	**Reference**	**Basis / Program Description**
TB Floor and Equipment Drains	2	TR 116 Section 8.2	Inspections are in the program
Laundry/Laboratory	2	TR 116 Section 8.2	Inspections are in the program

Appendix 3 – Underground Piping Inspections

Item	Year	System/Location	Pipe and Coating	Inspection	Results	Comments/ Section in Report
1	1991	100 feet of Demin. Water and Condensate Transfer. Vicinity of the CST and the condensate Transfer Building	AL Exterior surfaces coated with liquid primer and protective tape; with magnesium anode Cathodic protection	External exposed by excavation	Sporadic Coating damage with External pitting.	Inspected during repair to items 7, 8, and 9 of appendix 1
2	1992	50 feet of Fire Protection	CS/ Coal Tar Exterior	External exposed by excavation and some internal	External Coating in good shape. Internal in good shape	Inspected during repair to item 10 of appendix 1
3	1992	50 feet of Service Water - South of the condensate Transfer Building	CS/ Coal Tar Exterior and Interior	External and internal inspections performed during repair activities see item #10 app #1	External Coating in good shape. Internal Coating in poor condition	Inspected during repair to item 10 of appendix 1
4	1993	25 feet of ESW System II -	CS/ Coal Tar Exterior and Interior	External and internal inspections	External Coating in good shape. Isolated Internal Coating Deterioration	
5	1993	20 feet of RBBCW	CS/ Coal Tar Exterior and Interior	External and Internal	External Coating in good shape.	
6	1993	Lube Oil Transfer Line pressure test	CS/ Coal Tar Exterior		Passed successfully	

Appendix 3 – Underground Piping Inspections

Item	Year	System/Location	Pipe and Coating	Inspection	Results	Comments/ *Section in* Report
7	1993	15 feet of Condensate Transfer and Fuel Pool cooling – South of the Reactor Building	AL Exterior surfaces coated with liquid primer and protective tape; with magnesium anode Cathodic protection	Exterior	Severe Pitting corrosion	Inspected during repair to item 12 of appendix 1
8	1993	15 feet Radwatse Piping CS – South of the Reactor Building	CS/ Coal Tar Exterior	Exterior	External Coating defects	Inspected during repair to item 12 of appendix 1
9	1993	10 feet of Fire Protection	CS/ Coal Tar Exterior	Exterior	Sporadic External Coating defects	Inspected during repair to item 12 of appendix 1
10	1993	15 feet of Turbine Building Drains and Equipment Drains South of the Reactor Building	Stainless/ Coal Tar	Exterior	Sporadic External Coating defects	Inspected during repair to item 12 of appendix 1
11	1993	15 feet of Roof Drains South of the Reactor Building	CS / Coal Tar	Exterior	Sporadic External Coating defects	Inspected during repair to item 12 of appendix 1
12	1993	20 feet of RB Equipment Drain Tank discharge - South of the Reactor Building	CS / Coal Tar	Exterior	Sporadic External Coating defects	Inspected during repair to item 12 of appendix 1
13	1993	15 feet of Laundry/Lab Drain South of the Reactor Building	CS / Coal Tar	Exterior	Sporadic External Coating defects	Inspected during repair to item 12 of appendix 1

Appendix 3 – Underground Piping Inspections

Item	Year	System/Location	Pipe and Coating	Inspection	Results	Comments/ Section in Report
14	1994	600 feet of 30" Overboard Discharge	CS / Coal Tar	Internal Video inspection	General in good condition / Visible coating defects and rust blooms	Inspected during repair to item 14 of appendix 1
15	1994	400 feet of 20" Service Water North of Reactor Building and West of turbine building	CS / Coal Tar	Internal Video inspection	Marine build-up and some rust blooms same condition as pipe in item #3	Inspected during repair to item 15 of appendix 1
16	1994	Service Water Northeast of Reactor building	During repair	Internal visual	Coating degradation with 4 significant pits found, 1 pit was 50 mils from through wall	Inspected during repair to item 15 of appendix 1
17	1994	Service Water Northwest of Turbine Building	During repair	Internal visual	Coating degradation with pitting found, 1 pit was 50% through wall	Inspected during repair to item 15 of appendix 1
18	1996	200 feet of 20" Service Water, West Turbine Building	During repair	Internal Video inspection	Marine build-up and some rust blooms same condition as pipe in item #3	Inspected during repair to item 18 of appendix 1
19	1996	80 feet of ESW System II piping inside the Turbine building	During modification to the system	Internal Video Inspection	- Occasional localized pitting corrosion, rust piles, coating bubbles and small openings in the coating.	

Appendix 3 – Underground Piping Inspections						
Item	**Year**	**System/Location**	**Pipe and Coating**	**Inspection**	**Results**	**Comments/ Section in Report**
20	1999	Inspected 900 feet of 30" overbroad discharge line just before the application of the new internal liner	During modification to install an internal liner	Internal Video Inspection	Marine build-up and some rust blooms	Section 6.2.2
21	2001	Inspected 150 feet of ESW 2 piping from penetration at the Northwest corner of the Turbine Building to the area near the leak at the branch connection	During investigate into the 2001 ESW System underground leak (CAP 2001-1233)	Internal Video Inspection	Marine build-up only except for leak at the branch connection weld.	Section 6.2.1
22	2004	UT inspection on Submerged ESW and SW pipe in the north intake bay	Devoe External and Internal	Visual and UT	Coating and pipe wall in general good condition with one exception.	Section 6.3
23	2007	Guided Wave Inspection of Lines	The following lines were inspected: A-1, A-4, CS-6, CS-8, CS-9, CS-10, CS-11, CS-24, CS-27, CS-31, CS-36, CS-37, CS-39, CS-40.	Guided Wave Technology	Results Described reference 10.24 and section 7 and 8.	
24	2008	South East Vault of Reactor Building	CS-6, CS-7, CS-8, CS-9, CS-10, and CS-11.	Visual	Coating Break Downs, IR 00813967 issued	See Section 8.2.2.4
25	2008	Condensate Transfer Lines	A-4	Visual	Coating in Good Condition	See Section 8.2.2.2

Appendix 3 – Underground Piping Inspections						
Item	**Year**	**System/Location**	**Pipe and Coating**	**Inspection**	**Results**	**Comments/ Section in Report**
26	2008	SW/ESW pipe	10 foot of SW and 20 foot of ESW removed from Intake Road	Visual	Coating in Good Condition	6.2

Appendix 4 - Inventory of Risk and Consequence Significant Lines - Aluminum Pipe											
ID	**Description System/ Line size**	**Susceptibility**	**Consequence**	**Len.**	**Fluid/ Contamination**	**Coating/ Protection**	**EL/ Depth**	**Draw.**	**Located**	**Inspections and Repairs**	**Action/ Basis**
A-1	CH-3, 12" Condensate Transfer line from CST to Core Spray System and CRD system. AL 6061 **Section 8.2.2.3**	High	Medium	3'	Condensate	Unknown	17'	2004 GE 885D781 237E487 4076 4079 2132 2138 2140	Between the TB and RB on Northwest corner of the RB,	In 1998 a project was performed to core bore the concrete slab above the gap in this area. A sample well was then installed under the condensate transfer line. The well showed that there was no moisture under the line. Soil samples indicated no condensate leak. Reference ETTS 4031 In 2007 this line was inspected using Guided Wave. Results were satisfactory.	Action: reinsert by 2013 years
A-2	CH-5; 6" Condensate. Transfer from Turbine Building to pipe tunnel to the Reactor Building Al. 6061 **Section 8.2.2.5**	Medium	Medium	<10'	Demin Water/ Medium	Unknown	19'	2195 2134 2004	Under Office Building.	This line was repaired in 1980. A vault was built around the line. This line is not direct buried	To be GW inspected in 2010 (IR 00686711)
A-3	NN-3 6" Fuel Pool Cooling line to Fuel Pool Filter in Radwaste – New line installed in 1993 Al. 6061	Low	Medium	<10'	Reactor Water/ Medium	Epoxy Coating w/ Nukon Wrap	19'	BR 2193 2153 GE 237E756	Central Vault /	This line was replaced in 1993, per BA 323721, OC-MM-323721-001 and SP-1302-12-268.	To be GW inspected in 2010=8 (IR 00686711)
A-4	CH-5; 6" from the Condensate pumps to TB Al. 6061 **Section 8.2.2.2**	Medium	Medium	25'	Condensate Transfer	Epoxy Coating	17'	2193 2132	Between the Condensate Transfer Building and the Turbine Building.	Original Vintage Piping. Original Plant underground line. However Coating Was repaired in 1992 Partially inspected in 2008 with good results	Excavate and inspect per ARA2116126 License Renewal Commitment

Appendix 4 - Inventory of Risk and Consequence Significant Lines - Stainless Steel Pipe

ID	Description System	Susceptibility	Consequence	Len.	Fluid / Contamination	Coating/ Protection	EL/ Depth	Drawings	Located	Inspections and Repairs	Action
SS-1	SD-4A; 3" RWCU Demin Resin Sluice/ Resin Transfer to Radwaste SS 304 **Section 8.2.3.2**	Low-inspected in 1993	High	<15'	RWCU Resins	Coal TAR and Repaired Epoxy Coating w/ Nukon Wrap	18' -5'	2195 2143 148F444 sh13	Under the Office Building; Southwest of Reactor Building	Line was inspected and repaired as necessary in 1993 This line is used once per cycle.	To be GW inspected in 2010 (IR 00686711)
SS-2	SD-4C; 3" Condensate for RWCU Demin Resin Transfer SS 304 **Section 8.2.3.2**	Low-inspected in 1993	High	<10'	Condensate /medium	Coal Tar and Repaired Epoxy Coating w/ Nukon Wrap	18' -5'	2195 2143 148F444	Under the Office Building; Southwest of Reactor Building	Line was inspected and repaired as necessary in 1993	To be GW inspected in 2010 (IR 00686711)
SS-3	NV-2; 1 ½" Laundry drains to Radwaste SS 304/ 316	Low	Medium	<10'	Water / Medium	Coal Tar and Repaired Epoxy Coating w/ Nukon Wrap	12' -11'	2195 2184 GE 148F432	Southeast Vault	A PM has been established to inspect coating of pipe in the southeast vault every 2 years (AR A2008369). Inspections of this line in 2001 and 2004 showed the coating is in good condition (CAP O2004-2071). Inspected in 2008	To be GW inspected in 2008 (IR 00686711)
SS-4	CH –2; 8" from TB to Sucker/Dumper Station; SS Replaced in 1992	Low	Medium	30'	Condensate	SS/Polyken Tape Tar	18'	2193 GU 3D-421-22-1000	From the Condensate transfer Building to the TB west wall.	Turbine Building. Replaced in 1992 OC-MM-323643-001	To be GW inspected in 2010 (IR 00686711)

Appendix 4 - Inventory of Risk and Consequence Significant Lines - Carbon Steel Pipe

ID	Description System	Susceptibility	Consequence	Len.	Fluid / Contamination	Coating/ Protection	EL/ Depth	Drawings	Located	Inspections and Repairs	Action
CS-1	ND-15; 1" Cleanup Sludge Transfer Line to sludge Tank A106 **Section 8.2.3.1.**	Medium Inspected in 1997	High; This line is probably the worst with respect to contamination levels Medium	<10'	Clean up Sludge/ High	Coal Tar/ and Repaired with Epoxy Coating w/ Nukon Wrap	19' -4	2195 2143 148F444 GE 148F437 sit 5	Central Vault /	In 1997 this line was in inspected and coatings repaired as necessary per the repair activities to NN-3, per BA 323721 and SP-1302-12-268. This Line cannot be Guided Wave Inspected	Pursue modification to replace this line
CS-2	NN-2; 6" Fuel Pool cooling to Radwaste (Fuel Pool Filter) A106 Filter Bypass **Section 8.2.4.1**	Medium	Medium	<10'	Reactor Water / Medium	Coal Tar and Repaired Epoxy Coating w/ Nukon Wrap	19' -4	2195 2153 GE 237E756	Central Vault /	In 1997 this line was in inspected and coatings repaired as necessary per the repair activities to NN-3, per BA 323721 and SP-1302-12-268.	To be GW inspected in 2010 (IR 00686711)
CS-3	ND-11; 6" Cleanup to High Purity Tank -This line is not used any more; However it is still available for service. A106 **Section 8.2.4.1**	Medium;	Medium	<15'	Reactor Water / Medium	Coal Tar and Repaired Epoxy Coating w/ Nukon Wrap	18' -5'	2195 2143 148F444	Central Vault /	In 1997 this line was in inspected and coatings repaired as necessary per the repair activities to NN-3, per BA 323721 and SP-1302-12-268.	To be GW inspected in 2010 (IR 00686711)
CS-4	ND-11; 6" Cleanup to Condensate	Medium Inspect	Medium	<15'	Reactor Water	Coal Tar and Repaired	18' -5'	2195 2143 148F444	Central Vault /	This line was inspected coating was found degraded – pipe wall was acceptable. Coating was	To be GW inspected in 2010 (IR

Appendix 4 - Inventory of Risk and Consequence Significant Lines - Carbon Steel Pipe

ID	Description System	Susceptibility	Consequence	Len.	Fluid / Contamination	Coating/ Protection	EL/ Depth	Drawings	Located	Inspections and Repairs	Action
	System A106 **Section 8.2.4.1**	ed			/ Medium	Epoxy Coating w/ Nukon Wrap				repaired MNCR 93-101	00686711)
CS-5	NV-6; 1 ½"RBEDT line to Radwaste – Ties in with NV-7 in the pipe Tunnel; A53 **Section 8.2.4.1**	Medium Inspected	Medium	<15'	Water / Medium	Coal Tar and Repaired Epoxy Coating w/ Nukon Wrap	18'4" -5'	2195 2184 147434	Partially in central Vault and under the Office building /	This line was in inspected and coatings repaired as necessary per the repair activities to NN-3, per BA 323721 and SP-1302-12-268 This Line may not be Guided Wave Inspected due to size limitation.	To be GW inspected in 2010 (IR 00686711)
CS-6	NV-4; 2" Laundry Drains to Radwaste A53 **Section 8.2.2.4**	High	Medium Low	<10'	Water / Medium	Coal Tar and Repaired Epoxy Coating w/ Nukon Wrap	12' -11'	2195 2184 148F437	Southeast Vault	Inspected in 1993; coating satisfactory – MNCR 93-143 Inspections of this line in 2001 was found satisfactory. This coating was again inspected in 2004 showing coating degradation requiring repairs (CAP O2004-2071). 2004 UT Inspection of this line showed no wall thinning. Coating degradation is believed to be due to the elevated temperatures this lines experiences. Inspected Using Guided wave in 2007 see reference 10.24 **Inspected in 2008**	PM57304M will inspect this line every 2 years
CS-7	NV-8; 3" RB sump to Radwaste A53	Low	Medium	<10'	Water / Medi	Coal Tar and Repaired	12' -11'	2195 2184 148F437	Southeast Vault	Inspected in 1993; coating was found degraded; repaired. UT showed piping wall acceptable –	PM57304M will inspect this line every 2 years

Appendix 4 - Inventory of Risk and Consequence Significant Lines - Carbon Steel Pipe

ID	Description System	Susceptibility	Consequence	Len.	Fluid / Contamination	Coating/ Protection	EL/ Depth	Drawings	Located	Inspections and Repairs	Action
	Section 8.2.2.4.				um	Epoxy Coating w/ Nukon Wrap				MNCR 93-143 Inspections of this line in 2001 and 2004 showed the coating is in good condition (CAP O2004-2071). **Inspected in 2008**	
CS-8	NV-7; 2" DWEDT to Radwaste Ties into NV-6 in the pipe tunnel. A53 **Section 8.2.2.4.**	High	Medium	<10'	Water / Medium	Coal Tar	12' -11'	2195 2184 148F437	Southeast Vault	Inspected in 93; coating satisfactory – MNCR 93-143. Inspections of this line in 2001 and 2004 show coating degradation requiring repairs (CAP O2004-2071). UT Inspection of this line showed a slight amount of wall thinning. Coating degradation is believed to be due to the elevated temperatures this lines experiences. **Inspected in 2008** Inspected Using Guided wave in 2007 see reference 10.24	PM57304M will inspect this line every 2 years
CS-9	NQ-2; 14" Containment Spray A53 Section 8.2.3.3	Low-	Medium	<10'	Torus Water / None	Coal Tar and Repaired Epoxy Coating w/ Nukon Wrap	11'6"	2195	Southeast Vault	Inspected in 1993; coating was found degraded; repaired. UT showed piping wall acceptable – MNCR 93-143 Inspections of this line in 2001 and 2004 showed the coating is in good condition (CAP O2004-2071). Inspected Using Guided wave in	PM57304M will inspect this line every 2 years

Appendix 4 - Inventory of Risk and Consequence Significant Lines - Carbon Steel Pipe											
ID	**Description System**	**Susceptibility**	**Consequence**	**Len.**	**Fluid / Contamination**	**Coating/** Protection	**EL/** Depth	**Drawings**	**Located**	**Inspections and Repairs**	**Action**
										2007 see reference 10.24	
CS-10	SA-2; 4" Service Air A106 **Section 8.2.3.3**	Low	Medium	<10'	Air/ None	Coal Tar and Repaired Epoxy Coating w/ Nukon Wrap	12' -11'	2195 2154	Southeast Vault	Inspected in 1993; coating was found degraded; repaired. UT showed piping wall acceptable – MNCR 93-143. Inspections of this line in 2001 and 2004 showed the coating is in good condition (CAP O2004-2071). Inspected Using Guided wave in 2007 see reference 10.24 **Inspected in 2008**	PM57304M will inspect this line every 2 years
CS-11	CA; 4" Instrument Air A106 **Section 8.2.3.3**	Low	High	<10'	Air/ None	Coal Tar and Repaired Epoxy Coating w/ Nukon Wrap	11' -12'	2195 2154	Southeast Vault	Inspected in 93; coating was found degraded; repaired. UT showed piping wall acceptable – MNCR 93-143. Inspections of this line in 2001 and 2004 showed the coating is in good condition (CAP O2004-2071). **Inspected in 2008** Inspected Using Guided wave in 2007 see reference 10.24	PM57304M will inspect this line every 2 years
CS-12	CH-8; 3" Heating steam Condensate A53	Low	Medium	<20'	Water / Medium	Coal Tar	19' -4'	2195 2197 BR 2015	South of RB Between the Central vault and the Southeast Vault.	Replaced in 2003. Coating was inspected in 2007	To be GW inspected in 2010 (IR 00686711)
CS-13	SH; 8" Heating Steam A53	Low	Medium	<20'	Steam / Medium	Coal Tar	18' -5'	2195 2197 BR 2015	South of RB Between the Central vault and the Southeast	Inspected in 2003 Subsequent analysis showed this line is acceptable See CAP O2003-1418	The entire line from the Pipe Tunnel to about 2 off the Reactor

Appendix 4 - Inventory of Risk and Consequence Significant Lines - Carbon Steel Pipe											
ID	**Description System**	**Susceptibility**	**Consequence**	**Len.**	**Fluid / Contamination**	**Coating/ Protection**	**EL/ Depth**	**Drawings**	**Located**	**Inspections and Repairs**	**Action**
									Vault.	Line leaked in the Pipe Tunnel Penetration in November 2007. The line was excavated and found to be in degraded condition (IR 00703721).	Building was replaced in November 2008 (AR A2181302). A new coating system was used due to the elevated temperature of the line.
CS-17	CC-4; 8" RBCCW supply Radwaste (Waste concentrator condenser and waste concentrator cooling coils). A106 **Section 8.2.4.2**	Medium	Medium	<10'	Water / None	Coal Tar	18 7"/ -4 ½'	2195 2145 BR 2006	Under Office Building between the Pipe tunnel and the Reactor Building. This line is not used but is pressurized.	Inspected in 1993	To be GW inspected in 2010 (IR 00686711)
CS-18	CC-3; 8"RBCCW return from Radwaste A106 **Section 8.2.4.2**	Medium	Medium	<10'	Water / None	Coal Tar and Repaired Epoxy Coating w/ Nukon Wrap	18'7"	2195 2145 BR 2006	Under Office Building between the Pipe tunnel and the Reactor Building. This line is not used but is pressurized.	Inspected in 1993	To be GW inspected in 2010 (IR 00686711)

Appendix 4 - Inventory of Risk and Consequence Significant Lines - Carbon Steel Pipe

ID	Description System	Susceptibility	Consequence	Len.	Fluid / Contamination	Coating/ Protection	EL/ Depth	Drawings	Located	Inspections and Repairs	Action
CS-19	AE-1; 30/36" Mechanical Vacuum Pump Offgas Line; A106 **Section 8.2.2.1**	High	High	410'	Offgas / medium	Coal Tar and Repaired Epoxy Coating w/ Nukon Wrap	2'8" – 9'6"	2192 4005 2008 2009	Between the Turbine building and the stack and the AOG.		To be GW inspected in 2010 (IR 00686711)
CS-20	AE-1; 48" Offgas Hold up; A106 **Section 8.2.2.1**	High	High	510'	Offgas/ Medium	Coal Tar	2'8" – 9'6"	2192 4005 2009 20008	Between the Turbine building and the stack and the AOG.		To be GW inspected in 2010 (IR 00686711)
CS-22	4" Off gas to AOG; A106; Line Spec- 0G-100 **Section 8.2.4.3**	Medium	Medium	100'	Offgas	Denso Anti Corrosion Tape	18'	M690 2009	Between The Stack and AOG Building		To be GW inspected in 2010 (IR 00686711)
CS-23	2" Off gas from AOG; A106; Line Spec- 0G-125 **Section 8.2.4.3**	Medium	Medium	100'	Offgas	Denso Anti Corrosion Tape	18'	M690	Between The Stack and AOG Building		To be GW inspected in 2010 (IR 00686711)
CS-24	CH-1; 10" from Cond. Tank & Cond. Building to Hotwell; A106 **Section 8.2.4.4**	Medium	Medium	30'	Condensate	Coal Tar	17'	2193	From the Condensate transfer Building to the west wall of the Turbine Building.	Inspected in 1993. Inspected Using Guided wave in 2007 see reference 10.24	Re inspect in 2012

Appendix 4 - Inventory of Risk and Consequence Significant Lines - Carbon Steel Pipe

ID	Description System	Susceptibility	Consequence	Len.	Fluid / Contamination	Coating/ Protection	EL/ Depth	Drawings	Located	Inspections and Repairs	Action
CS-26	CH –1; 1" from Cond. Building to Turbine Building; A106 **Section 8.2.4.5**	Medium	Medium	30'	Condensate	Coal Tar	18'	2193	From the Condensate transfer Building to the west wall of the Turbine Building	This Line cannot be Guided Wave Inspected	Pursue modification to replace this line
CS-27	CH –6; 12" overflow line from Cond. Tank & Demin Tank to Turbine Building; A106	Medium	Low	75'	Air	Coal Tar	16'	2193 2180	From the Condensate transfer tank and Demin tank to the west wall of the Turbine Building	Inspected Using Guided wave in 2007 see reference 10.24	Re inspect in 2012
CS-28	CW; 2 ½' Vacuum Priming Lines	Medium	Low	100'	Salt Water	Unknown	15'	2193	From TB to the top of the intake tunnel. A leak would results in a sinkhole.		To be GW inspected in 2010 (IR 00686711)
CS-29	DW-3; 3" Domestic water; A106	Medium	Medium	>400'	Domestic Water	Coal Tar	18'	2193 2192	Runs north to south west of the turbine building		To be GW inspected in 2010 (IR 00686711)
CS-30	DS-100, 1 ½"; AOG Drains and Sumps: A016 **Section 8.2.4.3**	Medium	Medium	175'	Sump	Denso Anti Corrosion Tape	18'	M690	From AOG to Boiler House		To be GW inspected in 2010 (IR 00686711)
CS-31	4"; Torus Water Tank Return Line to the Torus	Medium	Low	1000	Torus Water	Coal Tar	19 6"	S&W 15050-110-EM-	Between TWST Tank and North face of the	Inspected Using Guided wave in 2007 see reference 10.24 ( )	Re inspect in 2012

Appendix 4 - Inventory of Risk and Consequence Significant Lines - Carbon Steel Pipe

ID	Description System	Susceptibility	Consequence	Len.	Fluid / Contamination	Coating/ Protection	EL/ Depth	Drawings	Located	Inspections and Repairs	Action
	Section 8.2.4.7							650 and 651	Reactor Building.		
CS-35	3" Chlorine line from Chlorine Building to the Intake. (Three individual lines) **Section 8.2.4.6**	Low	Medium	400 each	Chlorinated water	Internal is Plastic external is coal tar	12'	BR2192	Between Chlorine House and Intake	The SW system line leak in 2007. These three lines were replaced in 2008	These three lines were replaced in 2008
CS-36	4" Chlorine line from Chlorine Building to the to top of Intake tunnel	Medium	Low	200	Chlorinated water	Internal is Plastic external is coal tar	12'	BR2192	Between Chlorine House and Turbine Building		To be GW inspected in 2010 (IR 00686711)
CS-37	CA - 2" Control Air Line **Section 8.2.3.4**	Low	High Possible Plant trip	600	Air	External is coal tar Pipe is Brass	8'	BR2192	From SW Corner of Turbine to Cond. Transfer Building and to the Intake		To be GW inspected in 2010 (IR 00686711)
CS-38	1" Condensate Line **Section 8.2.4.5**	Medium	Medium	30	Condensate	External is coal tar	6'	BR 2193	From CST to Turbine Building		Pursue modification to replace this line
CS-39	12" Fire Protection Line From Redundant Fire Pump	Low	Low	200	Fire Water	External is coal tar	6'	BR 2195	From Redundant Fire Pump	Inspected using Guided Wave in 2007	Re inspect in 2012
CS-40	10" Fire Protection Line to CST	Low	Medium	5	Fire Water	External is coal tar	6'	BR 2193	Line to CST	Inspected using Guided Wave in 2007	Re inspect in 2012

Appendix 4 - Inventory of Risk and Consequence Significant Lines - Carbon Steel Pipe

ID	Description System	Suscep tibility	Consequen ce	Len.	Fluid / Cont amin ation	Coating/ Protectio n	EL/ Depth	Drawing s	Located	Inspections and Repairs	Action
Cs-42	Turbine Lube Oil Transfer Lines Two Lines a 3" – LO-5 and a 4" LO-4	Mediu m	High	250'	Cont. Oil	Coal Tar	7'	BR 2193	West of Turbine Building	Inspected using Guided Wave in 2007	Re inspect in 2012

The following lines have been removed from the matrix since the last revision based on the following reasons:
The line has been modified above ground
The Line was abandoned and replaced by another line
The line was found to be above ground by a walkdown
The line carries Demineralized Water, which is no longer considered potentially contaminated.

Appendix 4 – Line no longer in the Program

ID	Description System/ Line size	Suscep tibility	Conseque nce	Len.	Fluid / Cont amin ation	Coating/ Protecti on	EL/ Depth	Drawing	Located	Comments	Action
A-5	WD-2; 3" Demin water to Turbine Building Pipe is PVC Reference S&S Specification 15050.66-1001	Low	Low	<15'	Demi n Water / Very Low	Above ground	18'4"	2195 2134 2004	From Demin Trailer to Turbine Building.	Demineralized Water System is no longer considered potentially contaminated.	No further Action
A-6	WD-2; 2" Demin Water transfer pump recirc lines to tank	Low	Low	<5'	Demi n Water /	Above ground	19'6"	2196 2004	Turbine Building to Condensate Transfer Building. Replaced in 1998	Demineralized Water System is no longer considered potentially contaminated.	No further Action

Appendix 4 – Line no longer in the Program											
ID	**Description System/ Line size**	**Susceptibility**	**Consequence**	**Len.**	**Fluid / Contamination**	**Coating/ Protection**	**EL/ Depth**	**Drawing**	**Located**	**Comments**	**Action**
	Al. 6061				Very Low				with above ground piping.	No longer underground Pipe	
A-7	WD-2, 4" Demin water from TB and Demin Trailer to Demin. Storage Tank. Al 6061	Low	Low	> 125'	Demin Water / Very Low	Above ground	16'	2192		Replaced in 1998 with above ground piping. Demineralized Water System is no longer considered potentially contaminated. No longer underground Pipe	No further Action
A-8	WD-1; 6" From the Demin Tank To Cond. Transfer Building Al 6061	Low	Low	>75'	Demin Water / Very Low	Above ground	16'	2192	Demin Tank To Cond. Transfer Building Al 6061	Replaced in 1998 with above ground piping.	No further Action
A-9	WD-2, 4' Demin water to Reactor Building, Located south of the Reactor Building, Al 6061	Medium	Low	> 125'	Demin Water / Very Low	Cathodic Protection	16'	2192	West of Cond. Transfer Building. Line was replaced in 1993.	Demineralized Water System is no longer considered potentially contaminated.	No further Action
A-10	WD-2, 2' Demin From base of the Stack to the Boiler house, Al 6061	Medium	Low	> 125'	Demin Water / Very	Unknown	16'	2192	From base of the Stack to the Boiler house, Al 6061	Demineralized Water System is no longer considered potentially contaminated.	No further Action

Appendix 4 – Line no longer in the Program											
ID	**Description System/ Line size**	**Susceptibility**	**Consequence**	**Len.**	**Fluid / Contamination**	**Coating/ Protection**	**EL/ Depth**	**Drawing**	**Located**	**Comments**	**Action**
					Low						
CS-25	CH –2; 8" from TB to Sucker/Dumper Station; A106	NA	NA	30'	Condensate	Coal Tar	18'	2193	From the Condensate transfer Building to the west wall of the Turbine Building	Replaced In 1992 With a Stainless Steel Line Reference OC-MM-323643-001 – Removed from this list and added to the SS list as SS-4	No further action Basis line replaced with SS line is being tracked on SS table as SS-4
CS-14	CH-8; 3" Condensate A53	Low	Low	<5'	Water / Medium	Coal Tar	19'6" -3'6"	2196 BR 2015	Boiler house to base of the Stack	Walkdown shows this line is not underground	No further Action.
CS-15	SH; 8" Heating Steam A53	Low	Low	<5'	Steam / Medium	Coal Tar	19'6" - 3'6"	2196 BR 2015	Boiler house to base of the Stack	Walkdown shows this line is not underground	No further Action.

Appendix 5 –Specific Service Life Assessments 2007.

Configuration/ Process Fluid	Degradation Mechanism	Specific Lines	Expected Coating Life (1)	Expected Corrosion Rate (2)	Expected Minimum Service Life	Last Inspection or Repair	Assumptions (3)	End of Predicted Service Life 1+(3/2)	Basis/ Reference/ Action	Reference Section/
Carbon Steel Pipe with Coal Tar Enamel internal coating and Salt water	Internal localized coating failure	ESW	0 to 40 years	10- 18 mpy					ESW and SW History/ TDR 829	
		ESW Lines	0 to 40 years	19 to 30 years	Minimum of 19 years	Replaced in 2008	Assumed 350 mil margin to Tmin	2027		6.2.1
		SW	0 to 40 years	4 – 16 mpy					ESW and SW History/ TDR 829	
		SW lines	0 to 40 years	25-60	Minimum of 25 years	20% Replaced in 2008	Assumed 400 mil margin to Tmin			6.2.1
Carbon Steel Pipe with Coal Tar Enamel external coating direct buried	Coating End of Service Life	General	15 to 40 years	5 to 20 mpy					1992 SW Leak / TP 116	
		CS-19 and CS-20	15 to 40	25 - 60 years	Minimum of 40 years	1969	Assumed 475 mil margin to Tmin	2009	GW Planned in 2010	8.2.2.1
		CS-1	15 to 40	No Credit	Minimum of 15 years	1997		2012	Replacement Planned	8.2.3.1
		CS-17 & CS-18	15 to 40	No Credit	Minimum of 15 years	1993		2008	GW Planned in 2010	8.2.4.2
		CS-24	15 to 40	12 – 50 years	Minimum of 27 years	1993 2007(GW)	Assumed 250 mil margin to Tmin	2012		8.2.4.4
		CS-26	15 to 40	4 – 15 years	Minimum of 19 years	1993	Assumed 75 mil margin to Tmin	2012	Replacement Planned	8.2.4.5
		CS-27	15 to 40	5 to 20 mpy	Minimum of 20 years	2007(GW)	Assumed 75 mil margin to Tmin	2012	Re inspect 2012	
		CS-35	15 to 40	8 – 30 years	Minimum of 23 years	Early 1980	Assumed 150 mil margin to Tmin	2029	Replaced all in 2008	8.2.4.6
		CS-2, CS-3, CS-4, and CS-5	15 to 40	6 – 25 years	Minimum of 21 years	1997	Assumed 125 mil margin to Tmin	2018	GW Planned in 2010	8.2.4.1
		CS-31	15 to 40	8 – 30 years	Minimum of 23 years	Mid 1980's	Assumed 150 mil margin to Tmin	2008	Abandoned	8.2.4.7

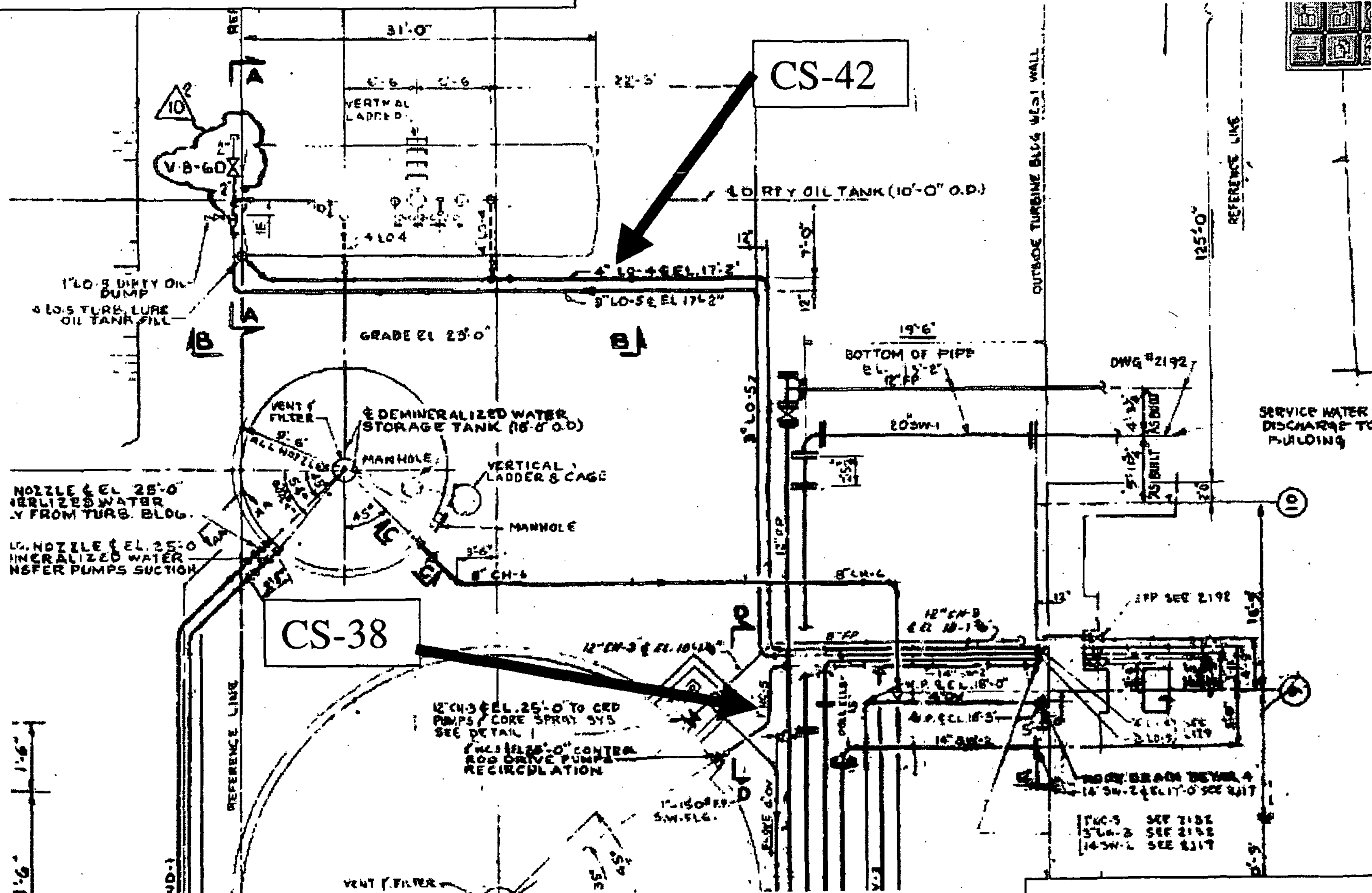
Appendix 5 –Specific Service Life Assessments 2007.

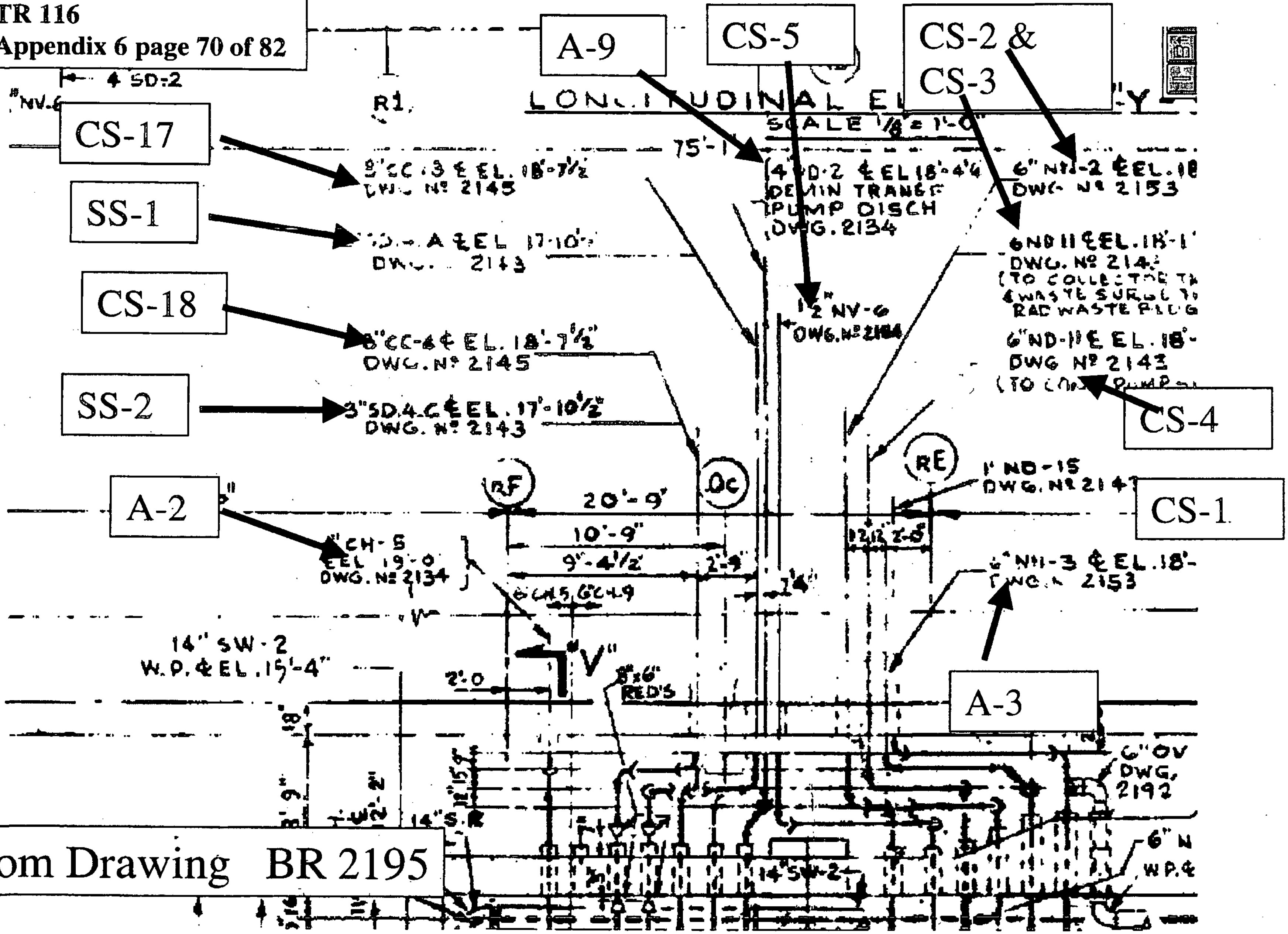
Configuration/ Process Fluid	Degradation Mechanism	Specific Lines	Expected Coating Life (1)	Expected Corrosion Rate (2)	Expected Minimum Service Life	Last Inspection or Repair	Assumptions (3)	End of Predicted Service Life 1+(3/2)	Basis/ Reference/ Action	Reference Section/
		CS-22, CS-23 &CS-30	15 to 40	10- 40 years	Minimum of 25 years	Early 1980's	Assumed 200 mil margin to Tmin	2010	GW Planned in 2010	8.2.4.3
	Elevated process temperatures. Small bore lines	General	2-10 years	5 to 20 mpy					2003/ Heat Steam Condensate Return line failure / TP116	
		CS-10 CS-11 CS-9,	10 years	8 to 30 years	Minimum of 18 years	2007 GW Inspected in 2008	Assumed 150 mil margin to Tmin	2022	Re inspect 2010\Per PM PM57304M	8.2.3.3
		CS-6 CS-7 CS-8	No credit	5 to 20 years	Minimum of 5 years	2004 Inspected in 2008	Assumed 100 mil margin to Tmin	2009	GW Planned in 2010 Per PM PM57304M	8.4.2.4
Aluminum Pipe with Coal Tar Enamel external coating direct buried	Improper Application	General	15- 40	16 – 20 mpy in wet soil 5 to 10 mpy in dry soil					1980 and 1996 DW-1 and DW-2 failures and TP 116 <u>The Corrosion Handbook</u> edit by UHLIG,	
		A-4	0	30 mpy	Minimum of 8 years	1993 2007 GW Inspected in 2008	Assumed 250 mil margin to Tmin	2016	Re inspect in 2016	8.2.2.3
		A-2	15 - 40	Dry soil - 20 to 40 years	Minimum of 35 years	mid 1980's	Assumed 200 mil margin to Tmin	2015	GW Planned in 2010	8.2.3.5
		A-1	0	Dry soil - 20 to 40 years	Minimum of 40 years	1998 2007 GW	Assumed 200 mil margin to Tmin	2012	Re inspect in 2012	8.4.2.3

Appendix 5 –Specific Service Life Assessments 2007.

Configuration/ Process Fluid	Degradation Mechanism	Specific Lines	Expected Coating Life (1)	Expected Corrosion Rate (2)	Expected Minimum Service Life	Last Inspection or Repair	Assumptions (3)	End of Predicted Service Life 1+(3/2)	Basis/ Reference/ Action	Reference Section/
Stainless steel with Devoe or Coal Tar Coating -	Unknown	General	15 to 40 years	5 to 10 mpy					Limited corrosion data is available However from <u>Corrosion Engineering</u> by M Fontana C 1986 – a rate of 5 to 10 MPY was observed	
		SS-1 and SS-2	15 to 40 years	15 to 30 years	Minimum of 30 years	1993	Assumed 150 mil margin to Tmin	2022	GW Planned in 2010	8.2.3.2
Brass	Unknown	General	15 to 40 years	1 – 5 mpy					Corrosion rate range from <u>Corrosion Handbook</u> from UHLIG Table10 page 458	
		CS-37	15 to 40 years	25- 60 year	Minimum of 40 years	1968	Assumed 125 mil margin to Tmin	2009	Replace in 2010	8.2.3.4

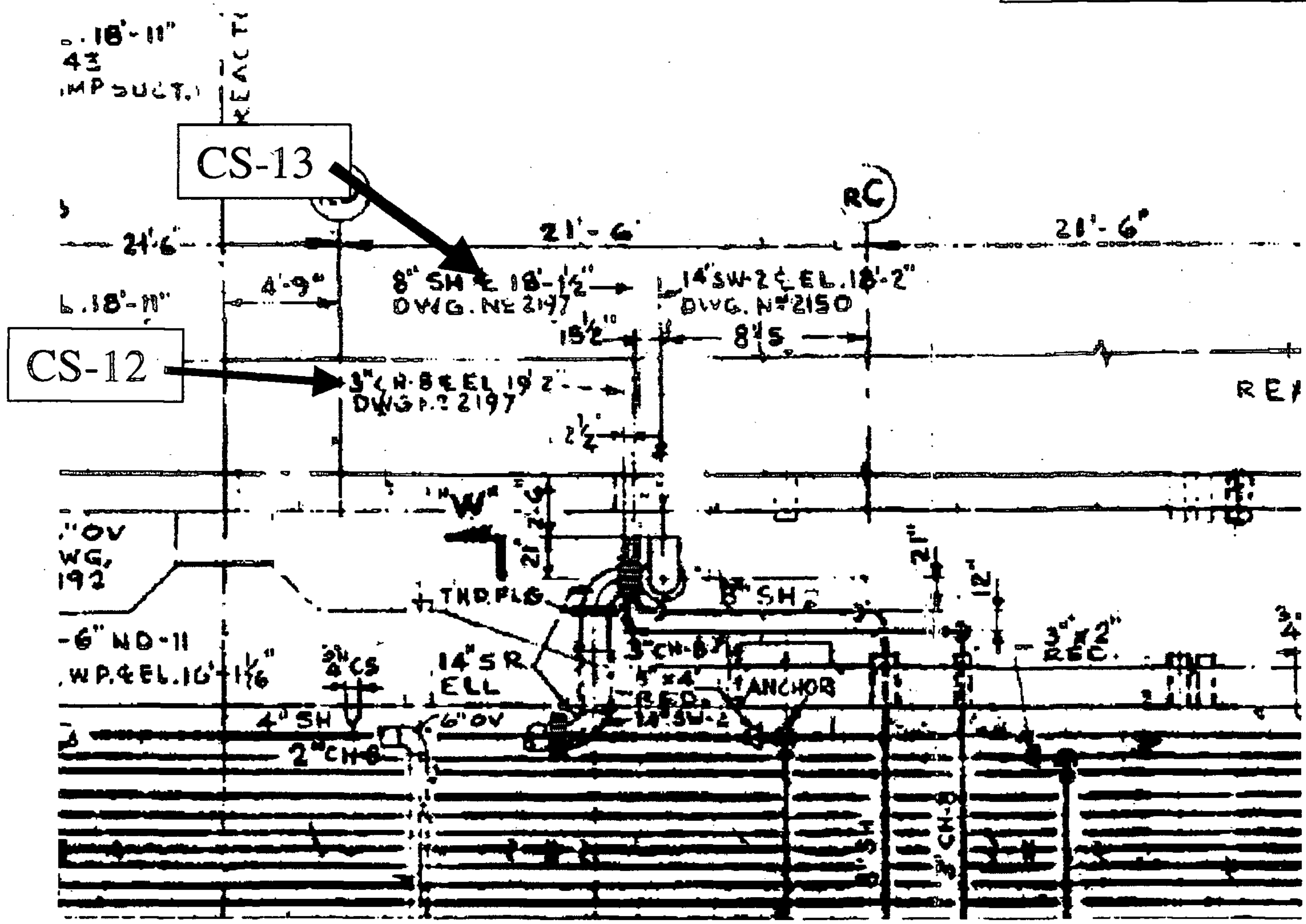
From Drawing BR 2193





From Drawing BR 2195

From Drawing BR 2195



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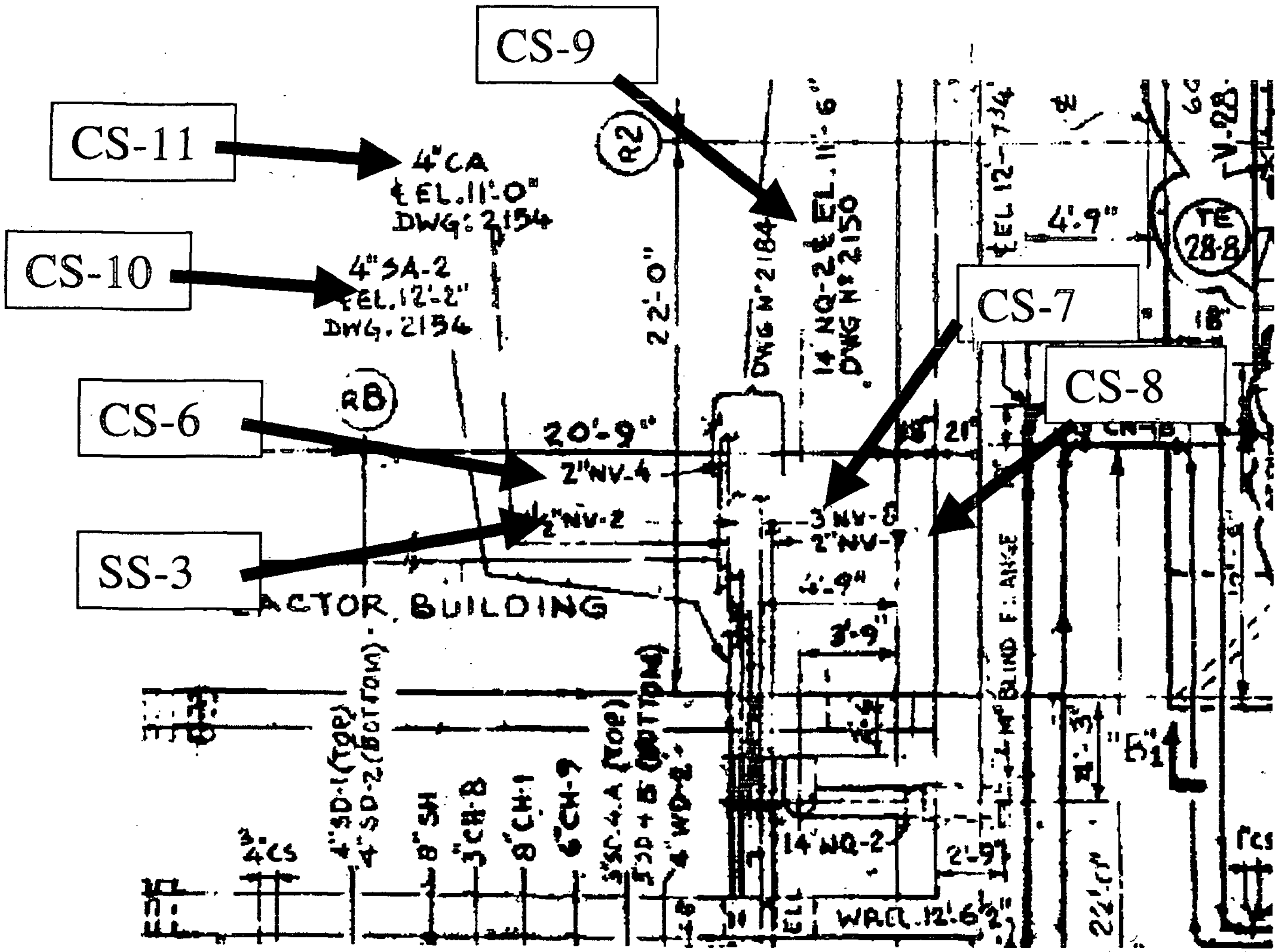

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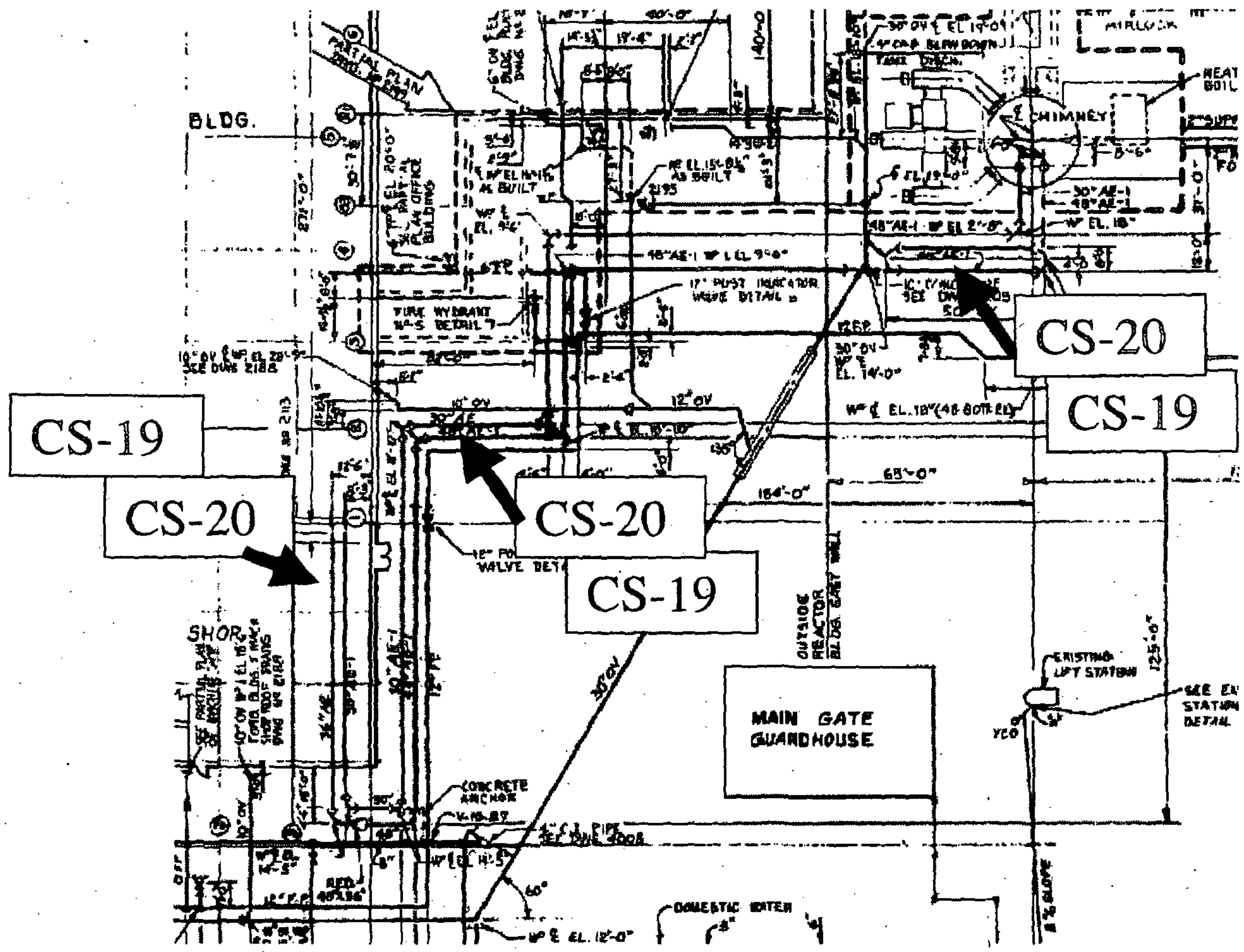

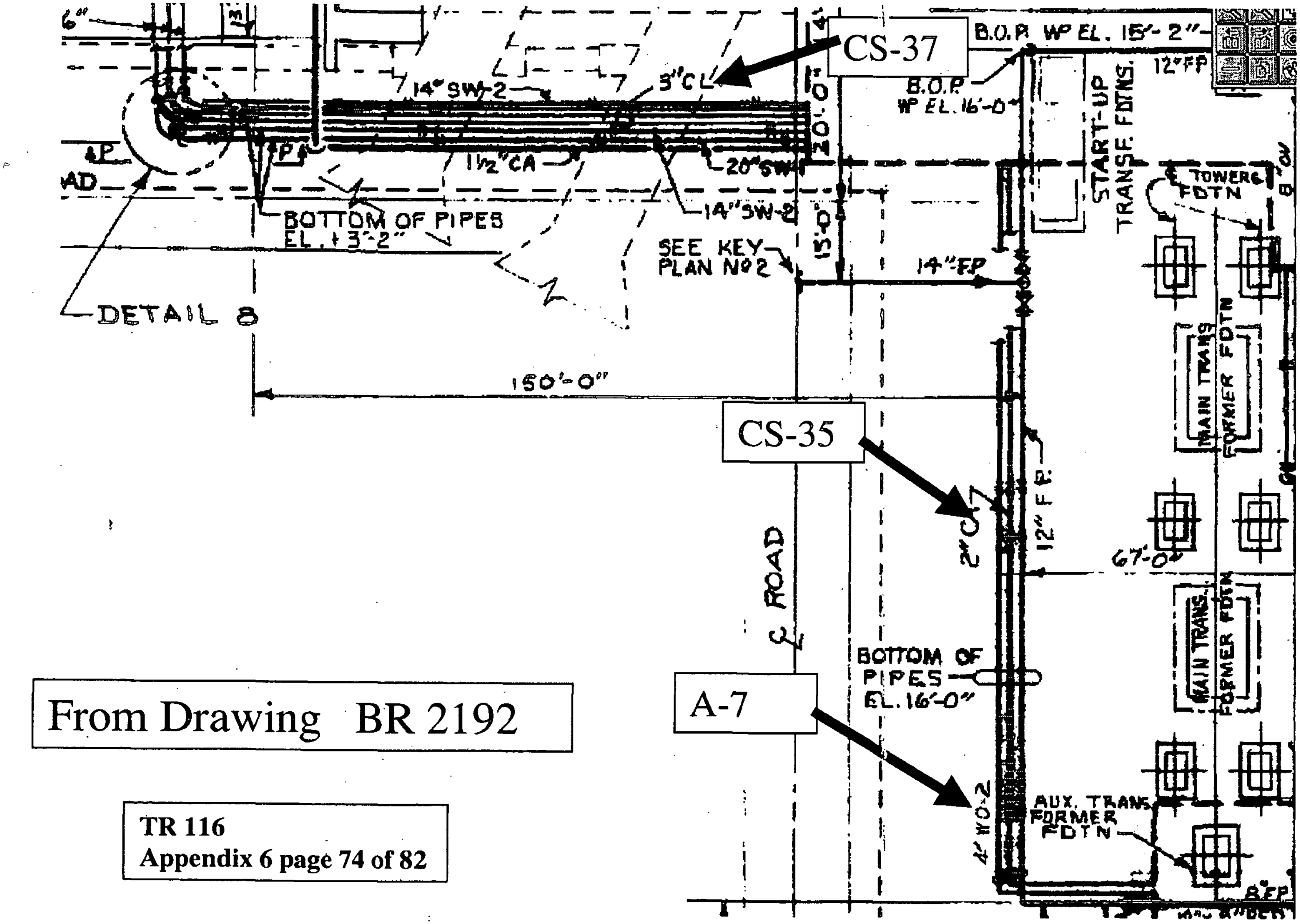

From Drawing BR 2192

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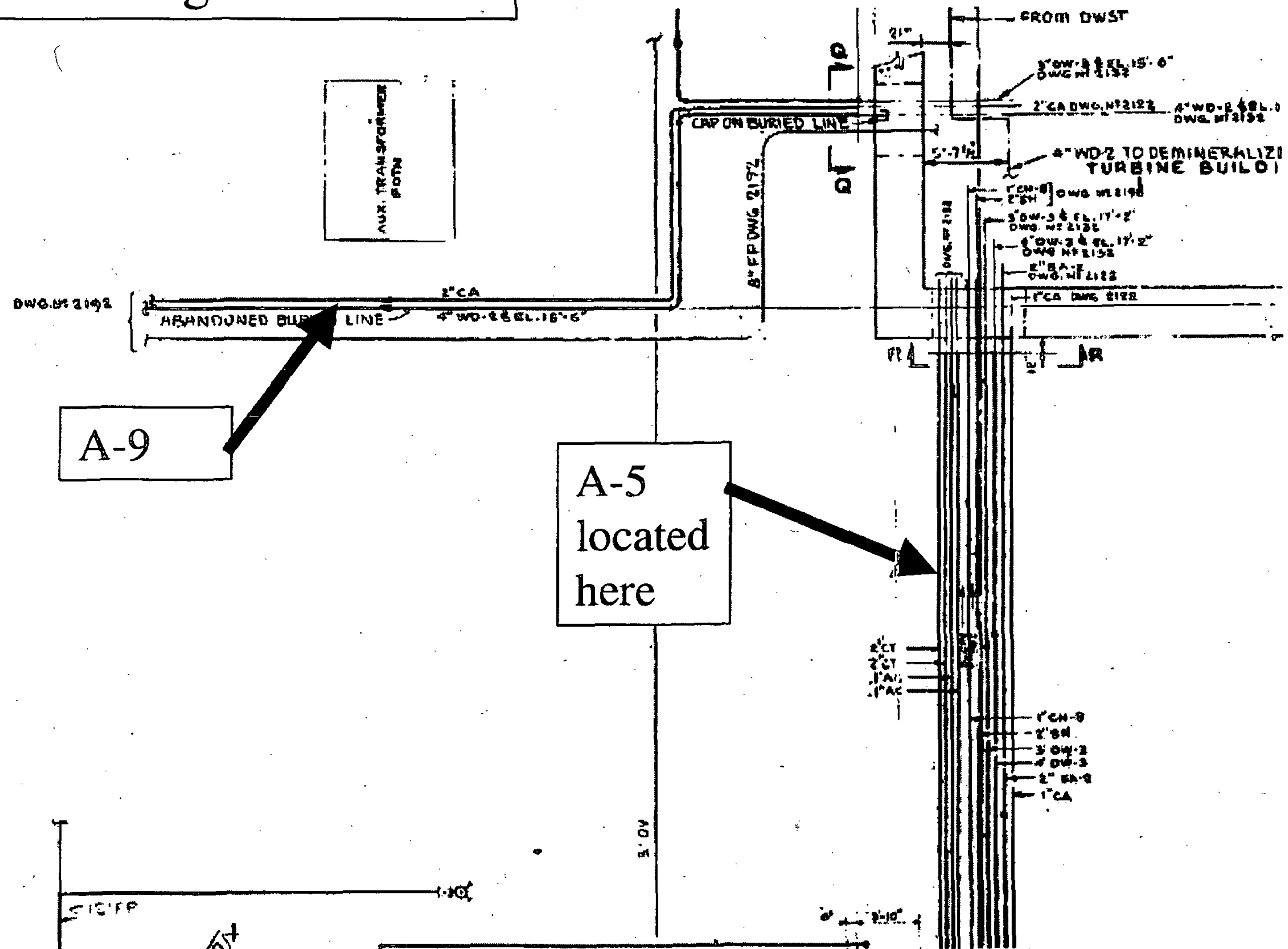
From Drawing BR 2194



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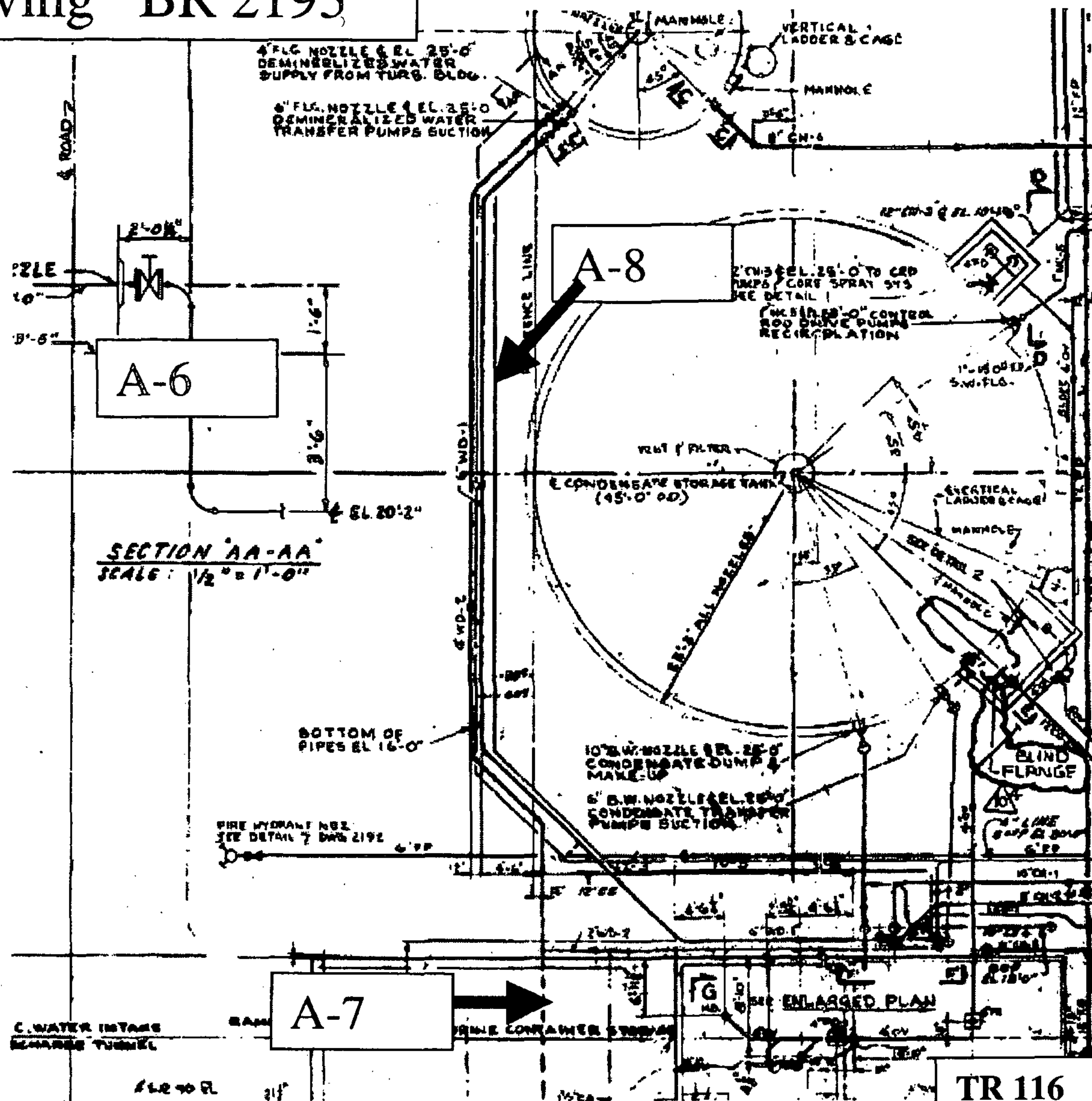

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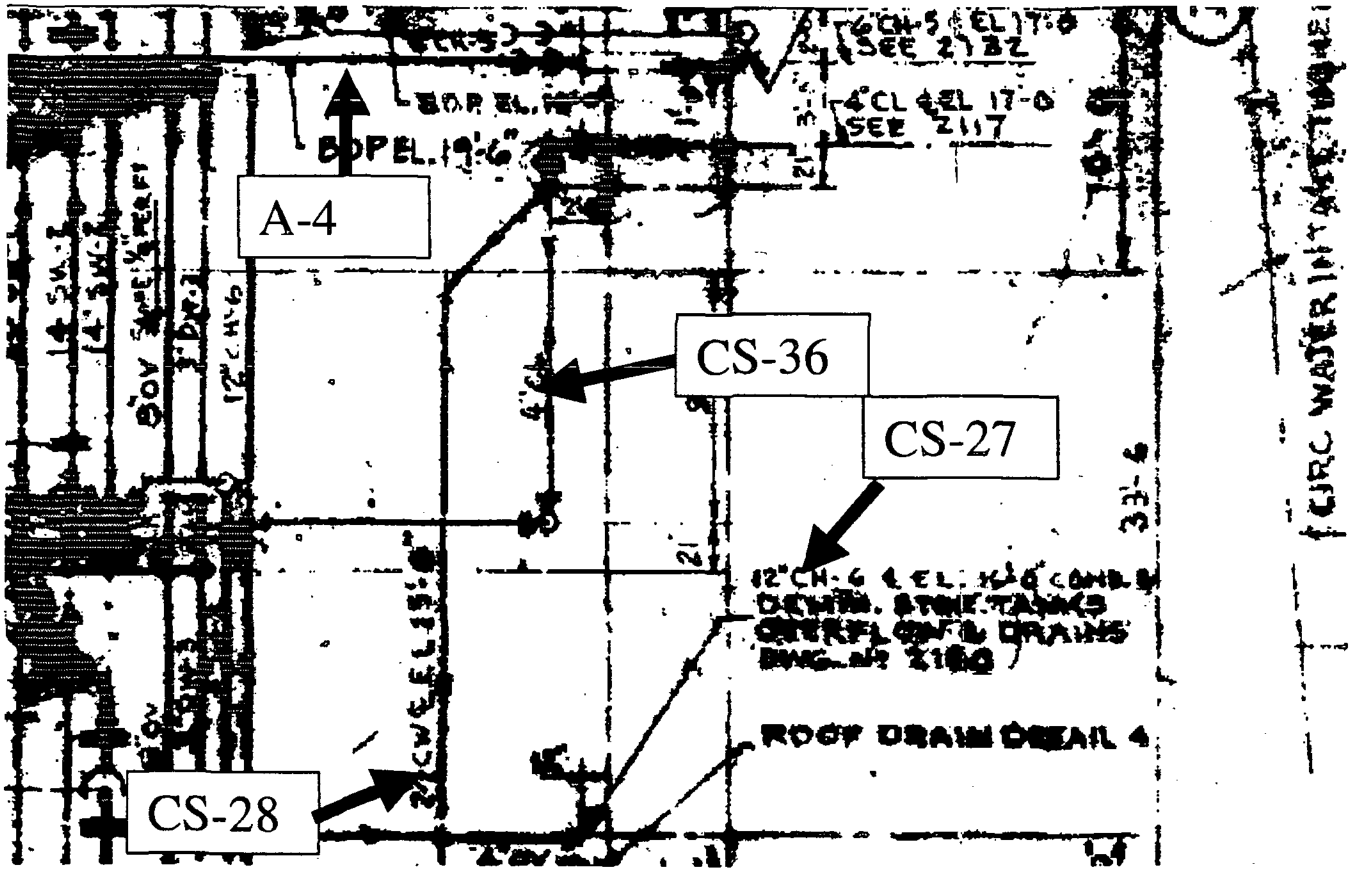

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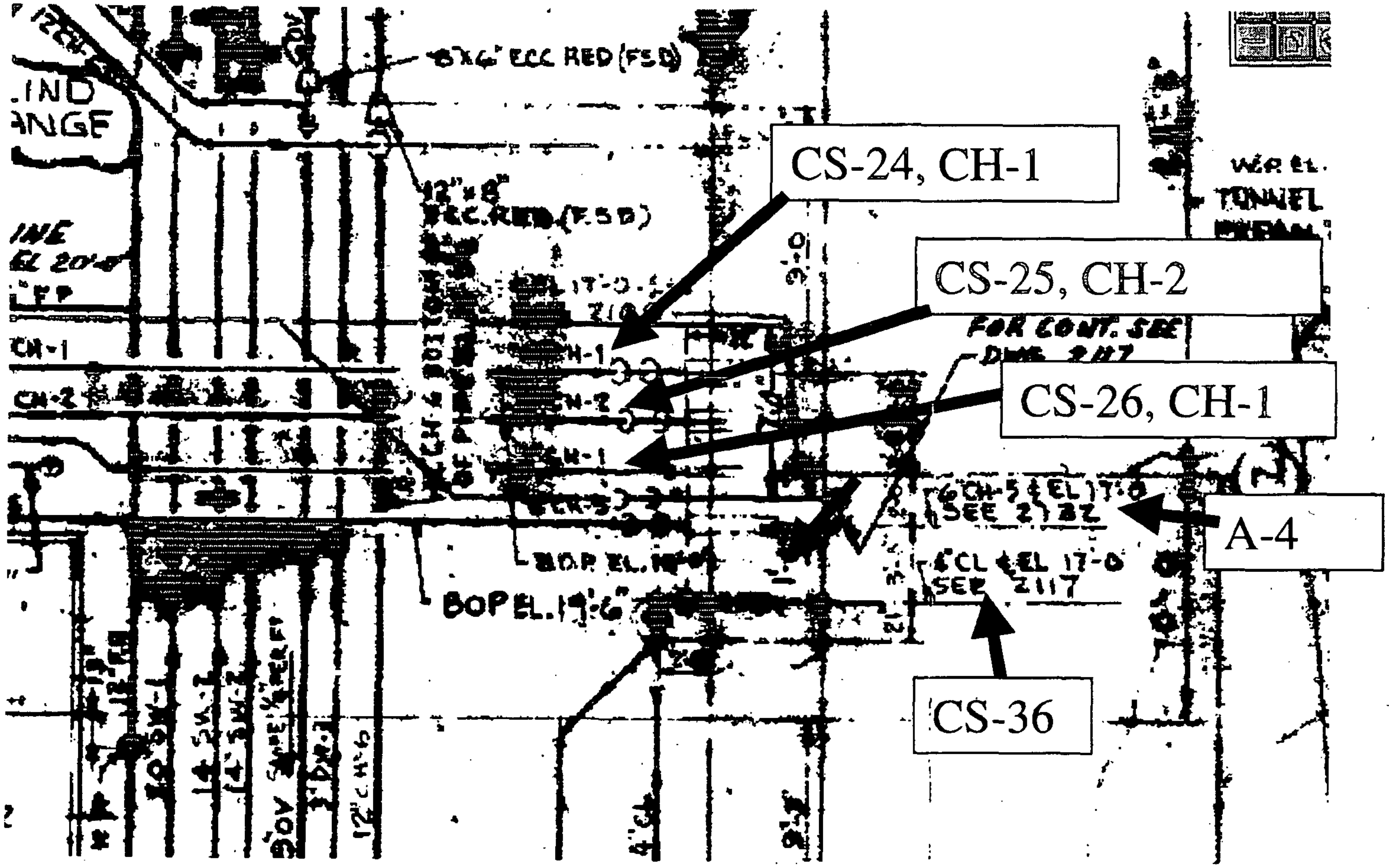

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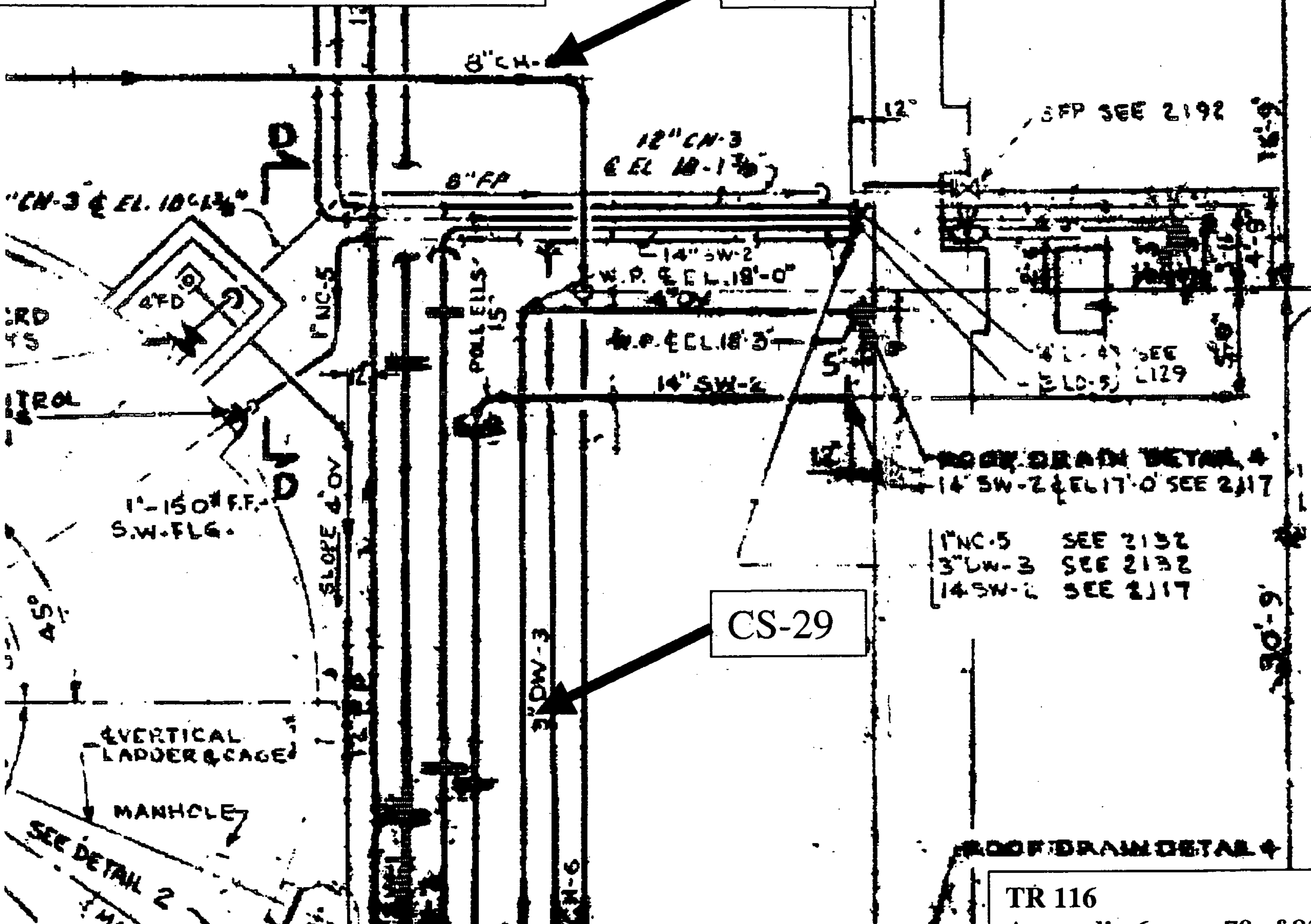

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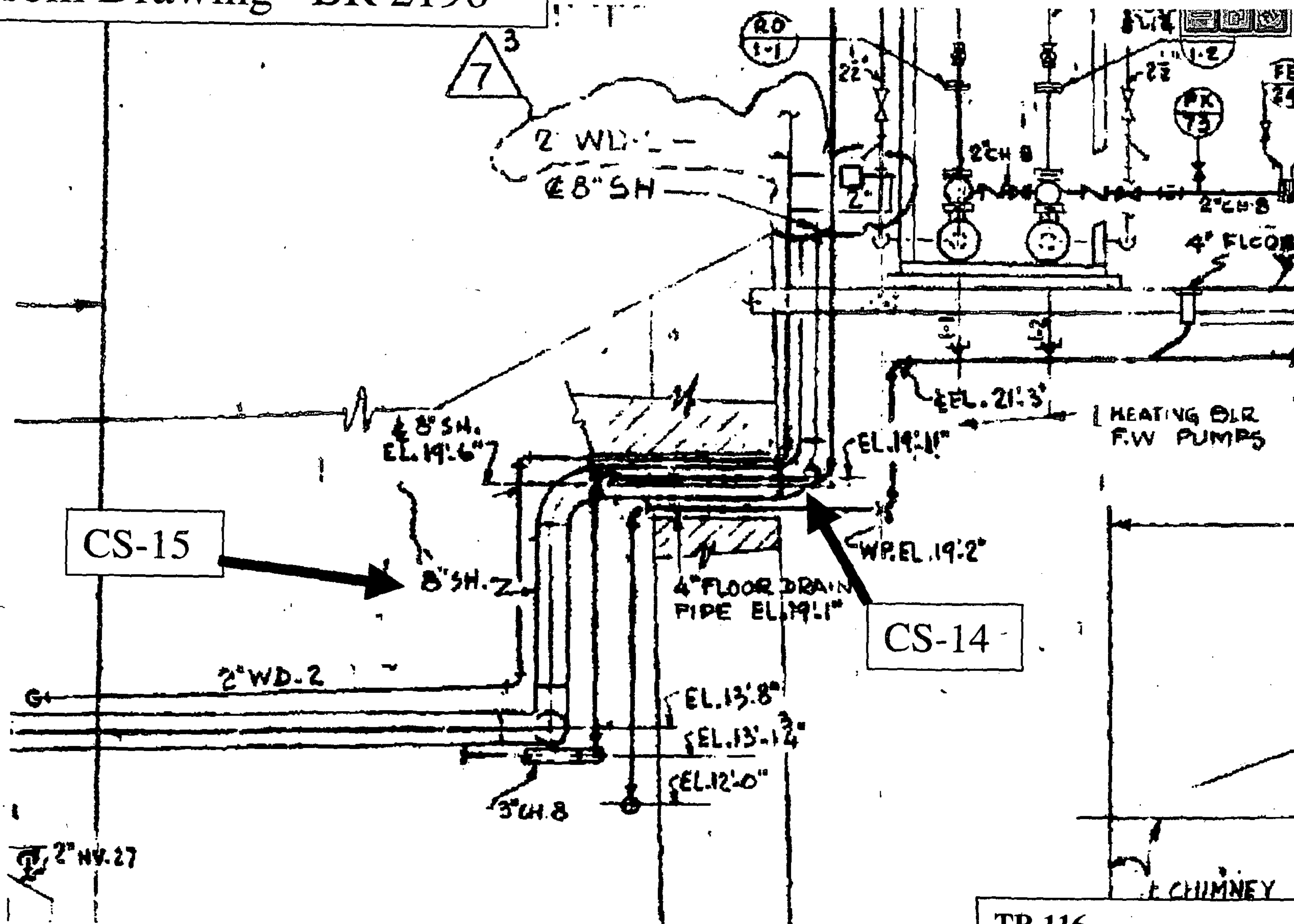
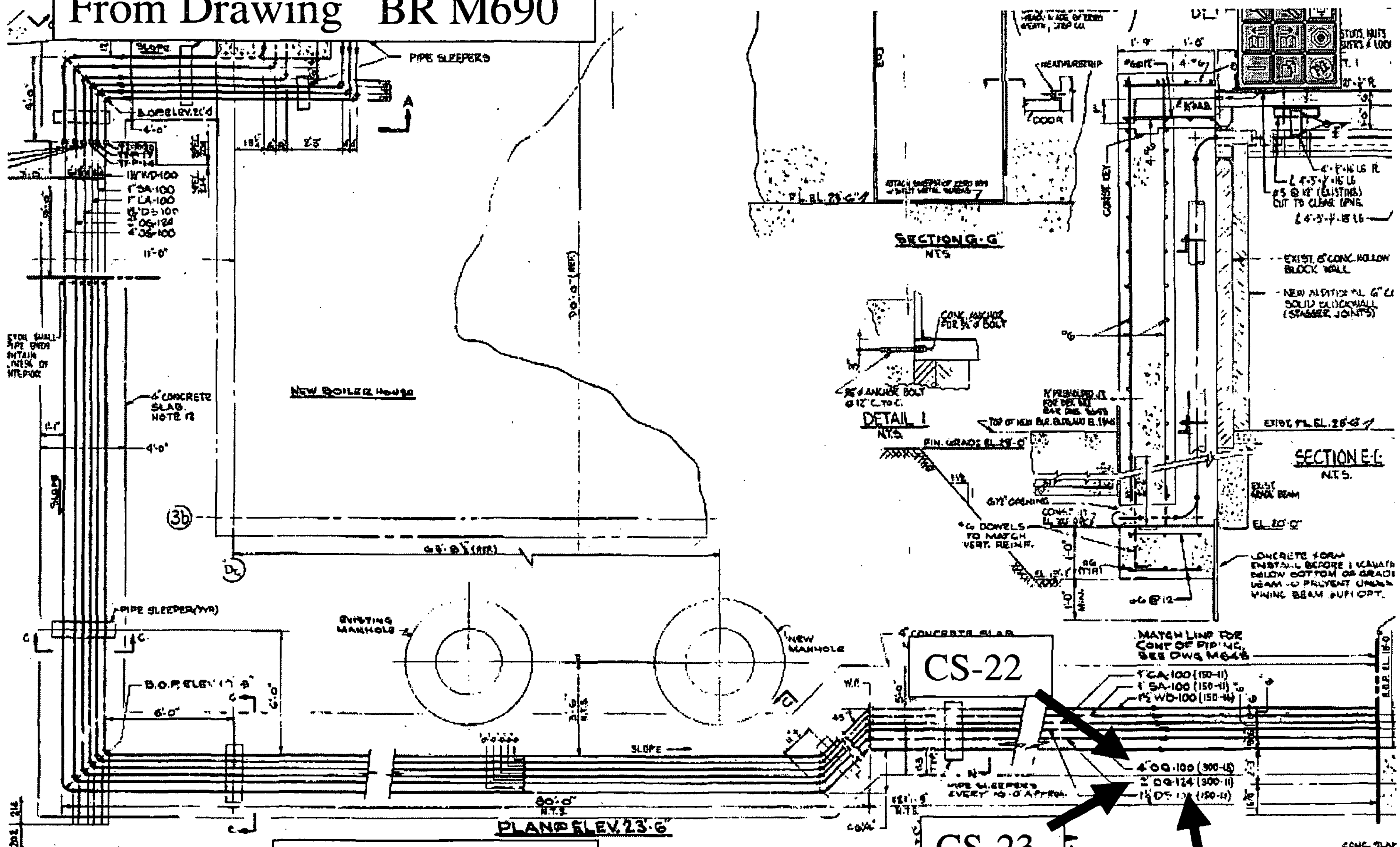


From Drawing BR M690



From Drawing 15050-110-EM-651