5.3.2 Diesel Fuel Oil System

5.3.2.1 Scoping

System Description

The Diesel Fuel Oil (DFO) System provides a reliable supply of fuel oil to the emergency diesel generators, the auxiliary boilers, the station blackout diesel generator, and the diesel-driven fire pump. The UFSAR Section 8.4.1 discusses the DFO System.

Scoped SCs and Their Intended Functions

The DFO System was scoped and the components requiring an aging management review (AMR) were identified in accordance with the process described in Section 2.0. The portion of the DFO System within the scope of license renewal includes the fuel oil storage tanks, the piping and components associated with the fuel oil unloading station, and the piping and components from the tanks to the strainer at the diesel generator fuel oil transfer pumps. Several component types are common to many plant systems and perform the same passive functions regardless of system. For efficiency, these are addressed separately as commodity groups and are not included in this section. These include cables, component supports, process instrument tubing and components, and components required for fire protection only. As a result of these activities, four DFO System component types were determined to require an AMR. A list of these component types is given in Table 5.3.2-1.

TABLE 5.3.2-1

DFO SYSTEM COMPONENT TYPES REQUIRING AMR

Provided in Phase 1

Table 5.3.2-3 provides a list of references for the DFO System License Renewal Application. This list includes both industry and site-specific documents.

The DFO System components subject to an AMR provide the following passive intended functions:

a. Piping, tanks and in-line components maintain the pressure boundary of the system.

b. Electrical cables, and associated equipment, maintain electrical continuity for electrical components and/or protect these components from electrical faults.

c. Component supports provide structural support for DFO equipment.

d. Certain DFO System equipment supports the fire protection function.

All components in the system that perform functions b., c., and d. listed above, and process instrument tubing and process instrument components that support function a., are addressed in

commodity evaluations of cables, component supports, fire protection equipment, and instrumentation lines. Therefore, only the pressure retaining function for the component types listed in Table 5.3.2-1 is addressed in this section.

5.3.2.2 Aging Management

The potential age related degradation mechanisms (ARDMs) for the DFO System are identified in Table 5.3.2-2. Based upon system/component operating environment and component design, a number of these mechanisms were removed from further evaluation. These mechanisms are identified by a check mark (✓) in the "Not Plausible for System" column of Table 5.3.2-2. The plausible ARDMs are also identified in Table 5.3.2-2 by a check mark (✓) in the appropriate column.

TABLE 5.3.2-2

POTENTIAL AND PLAUSIBLE ARDMs FOR THE DFO SYSTEM

Potential ARDMs	Component Types for Which ARDM is Plausible				Not Plausible for System
	Piping	Check Valve	Hand Valve	Tank	
Cavitation Erosion					✓
Corrosion Fatigue					✓
Crevice Corrosion	✓	✓	✓	✓	
Erosion Corrosion					✓
Fatigue					✓
Fouling				✓	
Galvanic Corrosion					✓
General Corrosion	✓	✓	✓	✓	
Hydrogen Damage					✓
Intergranular Attack					✓
MIC	✓			✓	
Particulate Wear Erosion					✓
Pitting	✓	✓	✓	✓	
Radiation Damage					✓
Rubber Degradation					✓
Saline Water Attack					✓
Selective Leaching					✓
Stress Corrosion Cracking					✓
Stress Relaxation					✓
Thermal Damage					✓
Thermal Embrittlement					✓
Wear					✓

The following paragraphs provide the demonstration for each group of components subject to an AMR that the effects of the plausible aging identified in Table 5.3.2-2 are adequately managed such that there will be reasonable assurance that the intended function will be maintained consistent with the current licensing basis (CLB) during the period of extended operation.

NOTE: This example discusses only the ARDMs, methods, programs, and demonstration for the Diesel Fuel Oil Storage Tanks. In the actual technical report for the Diesel Fuel Oil (DFO) System, all DFO SCs would be discussed in a similar manner.

Fuel Oil Storage Tanks (FOSTs)

Due to the differences in environments affecting aging, the fuel oil storage tank discussion is divided into three sections: tank internal surfaces, tank bottom external surfaces and tank accessible external surfaces.

FOST Internal Surfaces - Materials and Environment

Provided in Phase 1

FOST Internal Surfaces - Aging Mechanisms.

Crevice corrosion, general corrosion, pitting, fouling and microbiologically influenced corrosion (MIC) are plausible ARDMs because the internal carbon steel material of construction could be exposed to fuel oil which, in turn, may be contaminated with water and/or biologics. Although, the interior surfaces of the fuel oil storage tanks are covered by a protective coating, no credit is taken for this coating when determining the plausible aging mechanisms. However, this coating does play an important role in the aging management of the tank as discussed in the following paragraphs.

If the diesel fuel oil is contaminated with water and comes into contact with the metal surfaces of the tank, general corrosion, crevice corrosion, pitting and MIC could occur and may result in uniform or localized loss of material from the tank interior surfaces. The effects of fouling would be a layer of deposits on tank interior surfaces that could lead to increased rates of pitting and general corrosion. Any aging effect that reduces the wall thickness of the tank, if left unmanaged, has the potential to cause leakage from the tank under normal or more severe loading conditions.

FOST Internal Surfaces - Methods to Manage the Aging Effects

Methods to manage aging of the fuel oil storage tank interior surfaces are discussed in two categories. Mitigation measures are activities which reduce the likelihood or rate of the ARDMs. Discovery techniques include those that can reasonably detect the effects of aging prior to loss of intended function and those that can confirm the absence of such effects by indirect means.

In order to mitigate the effects of crevice corrosion, general corrosion, pitting, fouling and microbiologically influenced corrosion, the conditions present within the tank that

cause these ARDMs can be controlled. Fuel oil is not corrosive to carbon steel under the conditions present in the fuel oil storage tanks. Significant rates of corrosion-related ARDMs only occur when water is present with the fuel oil in the tank. While the presence of water in the tank cannot be totally prevented, minimizing the amount of water and the length of time it may be present in the tank is an effective method to mitigate the effects of general corrosion, pitting, crevice corrosion, MIC and fouling. Additionally, since MIC is only possible if microbiological activity is present in the tank, sampling the tank for biological growth and taking appropriate action if positive indications are discovered is an effective technique to mitigate the effects of MIC. Corrosion inhibitors can also be added to fuel oil to contribute to maintaining a non-corrosive environment in the tank.

Significant rates of corrosion-related ARDMs occur only when tank metal surfaces come into contact with a fluid which may be corrosive. Thus another method to mitigate the effects of aging on the tank interior is to install a design feature, such as a coating, which prevents contact between the metal surfaces of the tank and the system fluid. Without such contact, the plausible ARDMs cannot occur. In addition to preventing the contact that could allow aging to occur, the coating also facilitates discovery methods as discussed in the following paragraphs.

The effects of the plausible aging mechanisms are detectable by visual techniques. Because corrosion of the interior surface of the tank cannot occur without degradation of the coating, which would allow the material of construction to come into contact with the contents of the tank, observing that this coating is intact is an effective method to ensure that the effects of the plausible ARDMs have not occurred. Since the tank coating does not contribute to the tank's intended function, observing the coating for degradation provides an alert condition which triggers corrective action before degradation that affects the tank's ability to perform its intended function could occur.

FOST Internal Surfaces - Aging Management Programs

A combination of mitigation and discovery methods are implemented through CCNPP programs and activities to manage the effects of aging on the intended function of the diesel fuel oil tanks. The plant programs and activities described below apply to the tank internal surfaces for all the fuel oil storage tanks subject to aging management review.

The following plant programs ensure that the presence of water in the fuel oil being loaded into the storage tanks is minimized and that the presence of a significant amount of water or the presence of biologics within the tank initiates the appropriate corrective actions.

The "Oil Receipt Inspection and Fuel Oil Storage Tank Surveillance" procedure requires sampling fuel oil prior to unloading to the fuel oil storage tanks and sampling of the fuel oil in the storage tanks at periodic intervals specified in the CCNPP Technical Specifications. This procedure also specifies limits for water, viscosity and sediment for both receipt inspection and technical specification surveillances in accordance with ASTM D975-81. The periodic sample of the tanks also includes a check for biologics. Target and action values are contained in the procedure for both receipt inspection and periodic surveillances. Corrective actions are taken if a target value is exceeded. If an

action value is exceeded, the frequency of the surveillances may be increased, corrective actions are taken, and a technical evaluation is requir... in accordance with a separate procedure entitled "Chemistry Technical Evaluations." Appropriate corrective action is taken based on this evaluation.

This procedure also requires that prior to unloading fuel oil to the fuel oil storage tanks and at periodic intervals while the fuel is stored in the tank, a corrosion inhibitor be added. Although the corrosion inhibitor is added to the fuel to minimize corrosion in the diesel engine itself, it will also aid in controlling corrosion of any exposed metal surfaces in the tank.

In addition to sampling the fuel oil and adding a corrosion inhibitor, steps are taken to remove water that accumulates in the tank. Tank design features ensure that water introduced into the tank collects in a sump at the tank bottom rather than in other local areas of the tank. Plant operating procedures require that water collecting in the bottom of the tank be drained periodically, thus minimizing the length of time that water is present in the tank. If excessive amounts of water are drained during this evolution, the cause of the excessive water must be determined and corrected, as required by the plant "Issue Reporting and Assessment" procedures.

The interior surfaces of the tanks are also covered by a protective coating which prevents contact between the metal surfaces and the system fluid. The protective coating for the internal surfaces of the FOSTs was applied in accordance with appropriate industry guidance.

In addition to the mitigation measures discussed above and to provide additional assurance that aging effects will not prevent the performance of the fuel oil tanks' intended function, CCNPP will perform an internal inspection of the fuel oil tanks at periodic intervals. This inspection includes the following features: 1) a visual assessment of the condition of the tank interior in accordance with American Petroleum Institute (API) Standard 653 for fuel oil tank inspections, 2) measurements of the thickness of the tank interior coating at several locations in the tank in accordance with ASTM Standard D-1186 for coating thickness measurements, and 3) observations for voids and pin holes in the tank coating in accordance with guidance in NACE RPO 188. The results of this inspection will be documented and used to assess the overall condition of the tank and the appropriate interval until the next inspection.

A recent inspection of a fuel oil storage tank using the standards listed above revealed that the tank is in good condition with no significant coating deterioration after approximately 20 years of service. Since the coating on the tank internal surfaces was found to be intact, no contact between the system fluid and the internal surfaces of the tank is occurring, and thus no age-related degradation of the carbon steel material of construction has occurred.

<u>FOST Internal Surfaces - Demonstration of Aging Management</u>

Based on the factors presented above, the following conclusions can be reached with respect to the fuel oil storage tank internal surfaces:

- The internal surfaces of the fuel oil storage tanks contribute to the pressure boundary function provided by the FOSTs.

- Crevice corrosion, general corrosion, MIC, pitting, and fouling are plausible for the internal FOST surfaces. Crevice corrosion, general corrosion, MIC, and pitting can cause uniform or localized loss of material from the tank interior surface, which can lead to loss of pressure boundary. In addition, fouling can lead to accelerated rates of pitting and general corrosion.

- The effects of crevice corrosion, general corrosion, MIC, pitting, and fouling can be mitigated by controlling the conditions present in the tank (i.e., minimizing the amount of water and biologics present and adding a corrosion inhibitor). In addition, providing a barrier (i.e., protective coating) to prevent contact between the metal surfaces of the tank and the system fluid precludes the occurrence of the identified ARDMs, as without such contact these ARDMs cannot occur.

- The "Oil Receipt Inspection and Fuel Oil Storage Tank Surveillance" procedure requires sampling for water, viscosity, and settlement upon receipt and periodically (as required by the TS) afterwards and includes target and action values for these parameters. Periodic sampling of the tanks also includes a check for biologics. If values given in the procedures are exceeded, appropriate corrective actions are taken, which include (when appropriate) a technical evaluation. The procedure also requires that corrosion inhibitors be added at the time of fuel oil receipt as well as periodically afterwards. In addition, a protective coating has been applied to the internal surfaces of the FOST, and this protective coating will be periodically visually inspected (at intervals to be determined by the results of previous inspections) for surface degradation and selected thickness measurements of the coating are taken to ensure its integrity.

- Results of a recent inspection, performed after 20 years of operation, confirmed that these programs are effective.

- Therefore, there is reasonable assurance that the effects of aging will be adequately managed for the internal surfaces of the tanks such that the fuel oil storage tanks will be capable of performing their intended functions consistent with the CLB during the period of extended operation.

<u>Tank Bottom External Surfaces - Materials and Environment</u>

Provided in Phase 1.

<u>Tank Bottom External Surfaces - Aging Mechanisms</u>

Based on a careful review of material of construction, external environment of the tank bottom and the existence of multiple design features which preclude contact between the metal surface of the tank bottom and any aggressive soil environment, the conclusion has been reached that there are no plausible ARDMs for the fuel oil storage tank external bottom surfaces.

The tank bottoms are coated with bitumastic superblack, which provides protection from galvanic corrosion. All weld seams are covered with asbestos strips to prevent contact between these welds and any aggressive soil environment. The tanks are set on a three inch layer of oil-soaked compacted sand which provides a benign environment for aging of any carbon steel which would come into contact with it. The outer edge of the tanks are anchored to a concrete ring and any voids between the tank bottoms and the concrete ring are filled with grout and the joint is sealed with a fibrated cold plastic coal tar pitch flashing. The tanks are located with their bottoms at an elevation of 46 feet, which is well above the ground water table; thereby preventing any direct contact between the tank bottom and the ground water table. The tank bottoms are also protected by an impressed current cathodic protection system. In addition, fuel oil storage tank 21 is located inside a protective enclosure.

An inspection of FOST 11 performed after approximately 20 years of service, verified that the preventive measures discussed above are effective. The inspection included a series of ultrasonic tests to measure the thickness of the 1/4 inch thick (by design) bottom plates. The minimum thickness measured during this inspection was .251 inches, with most inspection points showing more wall thickness.

Based on the extensive protective design features of the fuel oil storage tank bottoms, there are no aging mechanisms that could affect the exterior surface of the tank bottom to the extent that the tank could not perform its intended function during the period of extended operations. Therefore no aging management program is required. However, it is good engineering practice to periodically measure the thickness of the tank bottom when the tanks are opened and drained for the internal inspection discussed above (under Tank Internal Surfaces). Therefore, these measurements will continue to be a part of that inspection and will continue to reaffirm the conclusion that the tank bottom is not subject to any plausible aging mechanisms.

Tank Accessible External Surfaces - Materials and Environment

Provided in Phase 1.

Tank Accessible External Surfaces - Aging Mechanisms

Crevice corrosion, general corrosion and pitting are plausible ARDMs because the external carbon steel material of construction is potentially exposed to humid, moist or wet environments. Although Fuel Oil Storage Tank 21 is protected from the direct affects of sun and weather by a protective enclosure; the accessible surfaces of the tank are still subject to changes in humidity and temperature. The external surfaces of the FOSTs are covered by a protective coating; however, no credit is taken for this coating during the plausibility determinations. Nevertheless, this painted surface is an important factor in the aging management of the tank external surfaces as discussed in the following paragraphs.

If the carbon steel material of construction was directly exposed to humid, moist, or wet external environments, the affects of crevice corrosion, general corrosion and pitting would be uniform or localized loss of material from the accessible external surfaces of the tank. Any aging effect that reduces the wall thickness of the tank, if left unmanaged,

has the potential to cause leakage from the tank under normal or more severe CLB loading conditions.

Tank Accessible External Surfaces - Methods to Manage the Aging Effects.

Methods to manage aging of the fuel oil storage tanks' accessible external surfaces are discussed in two categories. Mitigation measures are activities which reduce the likelihood or rate of the ARDMs. Discovery techniques include those that can reasonably detect the effects of aging prior to loss of intended function and those that can confirm the absence of such effects by indirect means.

To mitigate the effects of the plausible ARDMs, the conditions on the external surfaces of the tank must be controlled. Significant rates of corrosion-related ARDMs only occur when the tank metal surfaces come into contact with moisture. Preventing direct and prolonged contact between metal surfaces and moisture (e.g., by providing a protective coating) is an effective mitigation technique for the ARDMs determined to be plausible for the accessible external surfaces of the tank.

The effects of the ARDMs that were determined to be plausible are detectable by visual techniques. Because the accessible external metal surfaces of the tank are covered by a protective coating, observing that this coating is intact is an effective method to ensure that these aging effects have not occurred. Because the coating does not contribute to the intended function of the tank, observing the coating for degradation provides an alert condition which would trigger corrective action before degradation that affects the tank's ability to perform its intended function could occur. Thus, frequent visual inspections of the coating condition performed by individuals familiar with the system and responsible for its condition are an effective method of ensuring that appropriate actions are taken to correct degraded coating conditions prior to loss of the tanks' intended functions.

Tank Accessible External Surfaces - Aging Management Programs

A combination of mitigation and discovery methods are implemented in CCNPP programs and activities to manage the effects of aging on the intended function of the diesel fuel oil tank accessible external surfaces. The plant programs and activities described below apply to all the fuel oil storage tanks subject to aging management review.

The external surfaces of the FOSTs are painted. Programs that inspect and preserve the paint are discussed under "discovery programs" below.

An individual is assigned to serve as the system engineer for the Diesel Fuel Oil System. In accordance with the Plant Engineering Guideline governing "System Walkdowns," the assigned system engineer for each system will walk down the system at regular intervals (typically monthly or as negotiated with the line supervisors). The purposes of this walkdown include "to identify and record any new or existing condition that could prevent the system from performing its intended function." The guideline governing these walkdowns contains a checklist for the system engineer to complete while performing the walkdowns. This checklist includes a step to ensure that coatings are applied and intact.

Conditions requiring corrective actions are documented on the walkdown checklist. If these conditions constitute a potential condition adverse to quality, the system engineer is required to document that concern in an Issue Report in accordance with a separate procedure governing "Issue Reporting and Assessment." This procedure specifies that issue reports receive review by a dedicated issues assessment unit which includes a determination as to whether the issue would require a review for generic implications and a root cause investigation. (A separate procedure governs the determination of which issues warrant a review for generic implication and root cause investigation.) Additionally, the issue reporting process requires that the reported condition is assigned to the appropriate individual or group for corrective action and requires that the status of that corrective action be tracked to its final completion. A plant procedure for "Painting and Other Protective Coatings" identifies when and how to correct the degraded condition. This procedure ensures that painting and protective coatings activities are consistent with applicable industry codes and standards. This procedure refers to a detailed standard which governs surface preparation, application of coatings, inspection and testing and quality controls.

The combination of system engineer walkdowns, the Painting and Other Protective Coatings program, and the issue reporting and assessment procedure will ensure that the painted surface of the fuel oil storage tank exterior will remain intact and/or receive timely and appropriate corrective actions, if significant coating deterioration is found to exist. Therefore, the protective coating will prevent prolonged contact between the metal surfaces of the tank exterior and any moist environment.

Tank Accessible External Surfaces - Demonstration

Based on the factors presented above, the following conclusions can be reached with respect to the fuel oil storage tank accessible external surfaces:

- The external surfaces of the FOST contribute to the pressure boundary function provided by the FOST.

- Crevice corrosion, general corrosion, and pitting are plausible ARDMs for the external surface of the FOSTs. Crevice corrosion, general corrosion, and pitting can lead to uniform or localized wall thinning, which can lead to a loss of pressure boundary integrity.

- Providing a barrier (i.e. protective coating) to prevent contact between the carbon steel external surfaces of the tanks and the external environment precludes the occurrence of the plausible ARDMs, as without such contact these ARDMs cannot occur.

- The external surfaces of the tanks are painted. The combination of system engineer walkdowns, the paint and protective coatings procedure, and the issue reporting and assessment procedure ensure that the paint applied to the external surface of the FOST is maintained in order to prevent long-term exposure of the material of construction to the external environment. Because the material of construction will

not be exposed to the external environment for extended periods of time, the effects of crevice corrosion, general corrosion, and pitting will be managed.

- Therefore, there is reasonable assurance that the effects of aging will be adequately managed such that the fuel oil storage tanks will be capable of performing their intended functions consistent with the CLB during the period of extended operation.

Conclusion

The programs discussed for the Diesel Fuel Oil System are listed in the following table. These programs are administratively controlled by a formal review and approval process. As demonstrated above, there is reasonable assurance that these programs will manage the effects of aging such that the intended functions of the Diesel Fuel Oil System will be maintained under all CLB conditions during the period of extended operation.

TABLE 5.3.2-3

LIST OF AGING MANAGEMENT PROGRAMS FOR THE DIESEL FUEL OIL SYSTEM

Program	Credited As
Oil Receipt Inspection and Fuel Oil Storage Tank Surveillance	Mitigation/discovery program for tank internal surfaces that ensures environments under which aging can occur are not present for extended time periods.
Operations Performance Evaluation Requirements--FOST Drain Water	Discovery program for tank internal surfaces that ensures environments under which aging can occur are not present for extended time periods.
Issue Reporting and Assessment	Discovery program used in combination with other plant programs for tank internal and external surfaces.
FOST Internal Inspection Program	Discovery program for tank internal surfaces to ensure that the tank internal surfaces protective coating is intact.
System Walkdowns	Discovery program for the tank external surfaces to ensure that the protective coating is intact.
Paint and Other Protective Coatings	Discovery program used in conjunction with system engineer walkdowns and issue reporting for maintaining the protective coating on tank external surfaces.

TABLE 5.3.2-4

LIST OF REFERENCES FOR THE DIESEL FUEL OIL SYSTEM

1. Aging Management Review Report for the Diesel Fuel Oil System, Revision 1.
2. CP-226, "Oil Receipt Inspection and Fuel Oil Storage Tank Surveillance," Revision 3, dated December 16, 1994.
3. Letter, V. Spunar to Distribution, 11 Fuel Oil Storage Tank Inspection (11/1/95), dated January 3, 1996.
4. MN-3-100, "Paint and Other Protective Coatings," Revision 1, dated June 25, 1995.
5. PEG-7, "Plant Engineering Section, System Walkdowns," Revision 4, November 30, 1995.
6. PEO-0-23-2-O-M, "FOST Drain Water," Revision 2, dated August 21, 1995.
7. QL-2-100, "Issue Reporting and Assessment," Revision 4, dated January 2, 1996.
8. CCNPP Updated Final Safety Analysis Report, Revision 19.