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OFFICE OF NUCLEAR REACTOR REGULATION

EVALUATION OF UNRESOLVED INSPECTION ISSUES RELATED TO THE

ADEQUACY OF TURBINE BUILDING FIRE AREA BARRIERS

CONSUMERS ENERGY COMPANY

PALISADES PLANT

DOCKET NO. 50-255

1.0 BACKGROUND

On November 3, 1995, Consumers Energy Company submitted a method and a schedule for dispositioning unresolved fire protection issues identified in NRC inspection report (IR) 255/95004 dated May 19, 1995. The unresolved issues identified were related to (1) the adequacy of the west wall of the turbine lube oil storage room to provide 3-hour fire resistive protection for safety-related equipment located in the turbine building, and (2) the adequacy of the turbine building/component cooling water (CCW) pump room wall to provide the level of fire safety needed to protect the CCW pumps in the event of a turbine building fire.

In a meeting with NRC Region III on October 24, 1995, the licensee stated that it would provide a response to the unresolved issues by March 31, 1996. In a subsequent conference call, the NRC staff requested that the licensee expedite its response in order to support a mid-February 1996 staff review of these issues. The licensee provided its analysis and response for these unresolved fire protection issues to the NRC on February 2, 1996.

The staff conducted its onsite review of these issues on February 12 and 13, 1996. At that time, the licensee stated that it would enhance the west wall of the turbine lube oil storage room and would provide additional sprinkler protection in the turbine building in the area of the turbine building/CCW pump room wall. In its onsite review exit meeting with the licensee, the staff requested that the licensee revise its February 2, 1996, submittal to document these planned enhancements.

By letters dated April 1, and December 9, 1996, the licensee revised its submittal to incorporate the fire protection enhancements it proposed to make in the turbine building and the turbine lube oil storage room. The December 9, 1996, submittal revised the April 1, 1996, submittal to delete certain nonconservative fire modeling techniques used to assess the fire safety vulnerabilities.

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2.0 EVALUATION OF UNRESOLVED TECHNICAL ISSUES

2.1 Turbine Lube Oil Storage Room West Wall

The turbine lube oil room is a free-standing room within the turbine building. This room does not provide structural support for the turbine building. However, the lower portions of two turbine building structural columns are located within the lube oil room near the west end. In addition, the 8-inch thick reinforced concrete slab, which forms the ceiling of the room, is supported by structural steel beams. Fireproofing materials are not applied to these structural elements.

The west wall of the turbine lube oil room was originally an exterior non-fire-rated wall. This wall is constructed of corrugated sheet metal attached to the turbine building structural steel and has no listed fire resistive rating. Subsequently, the licensee erected the feedwater purity building which included a pipe tunnel that runs along the west wall of the turbine building and interfaces with a portion of the turbine lube oil room non-fire rated wall. The lower 15 feet of this exterior wall interfaces with the feedwater purity building pipe tunnel, while the upper 6 feet of the wall remains an exterior wall. The remaining walls of the lube oil room are concrete block. The two doors in the south wall are 3-hour fire rated and the two ceiling equipment openings are protected by 8-inch thick concrete plugs. The tanks within the room are curbed. The curbing is designed to contain potential oil spills and is sized to contain a single tank rupture.

The turbine lube oil room is protected by a full area automatic wet pipe water sprinkler system that is designed to provide a water density of 0.55 gallon per minute per square foot of floor area for fires of up to 3,000 square feet of floor area. There is no automatic fire detection system provided for this room. The primary means of detection is the sprinkler system's water flow alarm which will provide an alarm to the main control room upon actuation of the sprinkler system. Manual suppression is provided to the turbine lube oil room by a hose station that is located at the turbine building entrance to the feedwater purity building pipe tunnel about 20 feet from the lube oil storage room. In addition, fire fighting foam equipment is located near the entrance to this room.

The combustible loading in the turbine lube oil room is classified as high. A significant fire in this room would initially achieve a free-burning state and then become ventilation limited until the envelope of the room enclosure is breached (e.g., fire door is opened to support fire fighting operations or fire-induced failure of the nonfire-rated west wall). If a fire were to occur in the turbine lube oil room, it is expected that the sheet metal west wall would remain intact until the automatic sprinklers actuated. However, if the suppression system fails or is out of service at the time of the fire, it is possible that the west wall could fail. This failure could occur due to sheet metal warpage or support failure from metal expansion. Under a free-burning fire condition it is expected that the upper wall would fail first due to the extended high temperatures experienced in this region of the room. Such failure would vent hot gases and smoke to the outside atmosphere. However, if the west wall of the turbine lube oil room were to fail in such a manner as to allow fire spread into the feedwater purity building pipe tunnel, it would expose two condensate feedwater pipes, a fuel oil transfer line for the feedwater purity building boiler, and four lightly filled

cable trays. These electrical cables transition from the cable trays and enter conduits approximately 20 feet from the south end of the feedwater purity building tunnel.

In the turbine building on elevation 590 ft-0 in., adjacent to and south of the feedwater purity building tunnel opening, equipment such as the heater drain cooler, feedwater heater, and air ejector are located. All cables in this area are routed in conduits. The waste oil tanks are located to the west of the feedwater purity building pipe tunnel south opening. These tanks are positioned approximately 20 feet away from the tunnel opening and are protected by a wet pipe sprinkler system with a water spray density of 0.30 gallon per minute per square foot of floor area.

The turbine lube oil room and feedwater purity building pipe tunnel do not contain any post-fire safe shutdown components. The closest safe shutdown component is located in the turbine building. This component is auxiliary feedwater steam supply valve CV-0522B. This valve is located behind a large feedwater heater and heater drain cooler. This equipment would tend to shield this valve from radiant heat from a fire in the feedwater purity building pipe tunnel near its south opening into the turbine building on elevation 590 ft-0 in. The south tunnel opening is more than 20 feet from the auxiliary feedwater steam supply valve and no intervening combustibles exist between the tunnel opening and the valve.

The closest adjacent structure containing safety-related equipment is the CCW pump room which is located on the east side of the turbine building. The unprotected openings in the CCW pump room wall that is common with the turbine building are more than 100 feet from the turbine lube oil room west wall and the feedwater purity building pipe/tunnel turbine building opening.

To prevent a turbine lube oil room fire from breaching the west wall and spreading into the feedwater purity building pipe tunnel, the licensee has replaced the sheet metal wall with a 2-hour fire-rated concrete block wall. The upper 6 feet of this wall, above the roof of the feedwater purity building pipe tunnel, remains sheet metal.

The existing fire protection features provided in the turbine lube oil room and the turbine building, along with the addition of the 2-hour fire-rated concrete block wall at the west end of the lube oil room, provide reasonable assurance that a fire in the turbine lube oil room will not present a fire exposure to the post-fire safe shutdown components located in the turbine building or the safety-related components in the CCW pump room.

2.2 Turbine Building/Component Cooling Water (CCW) Pump Room Wall

The wall that serves as the fire area boundary between the turbine building (Fire Area 23) and the CCW pump room (Fire Area 16) has a pressure release opening and nonfire-rated penetration openings around the main feedwater and main steam lines. The pressure release opening is on the 590 ft-0 in. elevation and is 7 feet wide by 9 feet high. A metal covering over the lower 5 feet provides flood protection from the turbine building side. This lower section also contains panels with breakaway supports to allow steam to vent from the CCW pump room in the event of a main steamline break in the CCW pump room. The upper 4 feet of the opening is protected with metal bars to prevent unauthorized

personnel entry while allowing free air flow between the turbine building and the CCW pump room.

The fire loading on the CCW pump room is low. However, fire hazards located in the turbine building present potential fire challenges to this fire area boundary. The fire hazards in the area of this opening consist of the turbine building steam-driven feedwater pumps, 480-V motor control centers (MCCs) and their associated cables (routed in cable trays), two 750-gallon lube oil reservoir tanks, and the turbine lube oil return piping.

Automatic smoke detectors are provided in the CCW pump room. These detectors are alarmed and annunciated in the main control room. The CCW pump room is not provided with an automatic suppression system. Manual hose stations are provided in the access hallway outside the auxiliary building entry door and in the turbine building outside the pressure relief opening.

The turbine building steam generator feed pump area, which is adjacent to the CCW pump room, is protected by a partial automatic sprinkler system. In addition, automatic sprinkler protection is provided over the combustible hazard areas, including the cable trays near the MCCs and the feed pump lube oil reservoir area on the 590 ft-0 in. turbine building elevation. Since the CCW pump room/turbine building pressure release opening cannot be fire rated, the licensee has enhanced the fire protection in this area on the turbine building side by extending the automatic sprinkler protection from column line J-17/J-22 to column line M-17/M-22.

Post-fire safe shutdown system cables and pump motors are located in the CCW pump room. In addition, operator actions must be taken in the CCW pump room to achieve post-fire safe shutdown. The safe shutdown functions are associated with the CCW system, the auxiliary feedwater (AFW) system, and the main steam system. The CCW system components, including the electrical cables and pump motors, are located in this room. The CCW system is required to support the decay heat removal function of the shutdown cooling system (cold shutdown operation). For a fire in this area, the licensee has developed a repair procedure for cold shutdown operations. This procedure governs the replacement of a pump motor with an onsite spare and the routing and replacement of the necessary cables to re-power the repaired CCW pump.

Due to the significant fire hazards in the turbine building, the licensee evaluated a worst-case fire scenario (i.e., smoke and hot gases) that breached the CCW pump room/turbine building wall. A turbine building fire on the 590 ft-0 in. elevation may result in damage to the control circuit logic (AFW pump P-8B) for the "B" train AFW steam supply valve and flow control valve. The remaining AFW System components located in the CCW pump room include the "A" train AFW steam supply and flow control valves and their associated control and logic circuits that support AFW pump P-8A and P-8C. The P-8C circuits are located in conduit approximately 2 feet behind and 4 feet to the side of the pressure release opening on the CCW pump room side. If smoke and hot gases from a significant turbine building fire were to enter the CCW pump room through the pressure release opening and damage the AFW P-8A and P-8C circuits, operator entry into the CCW pump room would be necessary to open the "A" train AFW steam supply valve and flow control valve in order to restore AFW flow to the steam generators. Under this fire scenario, the

operators have 45 minutes after the reactor is tripped to open these valves. On the basis of its analysis, the licensee has concluded that, if necessary, it can accomplish these actions because of the additional sprinkler protection it provided in the turbine building near the CCW pump room/turbine building wall pressure release opening.

The main steam system components requiring operation include the atmospheric steam dump valves (ASDVs) and the main steam isolation valve (MSIV) bypass valves. The ASDVs and the MSIV bypass valves are located on the upper level of the CCW pump room. Their associated control cables are routed through the lower level of the CCW pump room and the turbine building. The licensee assumed that the motive air and backup nitrogen sources for the ASDVs are lost in the event of a turbine building fire. Therefore, it provided a secondary method of releasing steam and rejecting decay heat through the use of the hogging air ejector which is also located in the turbine building. In order to operate the hogging air ejector, the MSIV bypass valves need to be open in the CCW pump room. Main steam safety valves will control the secondary steam pressure until the hogging air ejector can be manually operated. The operability of the hogging air ejector is necessary to allow secondary side heat removal to continue and to transition the plant to cold shutdown. The licensee's analysis takes credit for operator re-entry into the turbine building after the fire has been extinguished and the ability to manually restore the operation of the hogging air ejector. The staff could not determine from its review of the licensee's analysis what level of fire damage to the hogging air ejector was assumed or the level of repairs needed to restore its operability. The staff considers this to be a potential post-fire safe shutdown vulnerability which will be evaluated further in a future NRC inspection.

With respect to the pressure release opening in the CCW pump room/turbine building wall (fire area boundary wall separating Fire Area 16, the CCW pump room, from Fire Area 23, the turbine building), there are several other factors that will reduce the likelihood of a turbine building fire from propagating through the opening. These are:

> The large volume and ceiling height of the turbine building will dissipate the smoke and hot gases from a fire on the turbine building side of the CCW pump room/turbine building wall pressure release opening.
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> The inherent limitations on the locations and the amounts of transient combustibles that could be stored near the pressure release opening due to permanent plant equipment and a stair structure.
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> The in-situ combustibles are located at least 20 feet away from the pressure release opening on the turbine building side and the CCW pump room side. In the intervening space on the turbine building side floor drains are provided. These drains will aid in the removal of lube oil in the event of a failure of the lube oil system associated with the main feedwater pumps or the turbine.
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> The automatic sprinkler protection installed at the 590 ft-0 in. elevation of the turbine building on the east side of the turbine will control postulated fires and provide reasonable assurance that such fires will not spread to the opening. In

addition, the water from the sprinkler system will absorb energy from the fire and reduce the amount of radiant energy available at the opening.

If smoke from a turbine building fire enters the CCW pump room, the smoke detectors in the room will sense the condition and send an alarm to the control room.

An onsite five-member fire brigade that is trained and equipped in fighting combustible liquid pool fires is available to respond at any time.

The above considerations and the additional sprinkler protection provided for the turbine building area adjacent to the pressure release opening in the CCW pump room/turbine building wall (fire area boundary wall separating the CCW pump room from the turbine building) provide reasonable assurance that a fire in the turbine building will not propagate through the opening or present an undue fire hazard to post-fire safe shutdown and safety-related components located in the CCW pump room.

3.0 CONCLUSION

On the basis of its review, which included a site visit, as documented above, the staff concludes (1) the west wall of the turbine lube oil room, as modified by the licensee, provides reasonable assurance that a fire in the lube oil room will not adversely impact safety-related/post-fire safe shutdown equipment located in the turbine building, and (2) that the fire protection features provided in the vicinity of the common turbine building/CCW pump room wall, with the additional automatic sprinkler protection and the other factors described above, provide reasonable assurance that a fire in the turbine building will not adversely affect the CCW pumps and will not adversely affect the plant's ability to achieve and maintain post-fire safe shutdown.

As noted above, during its review of the unresolved inspection items, the staff could not determine what level of fire damage to the hogging air ejector was assumed by the licensee in its analysis or the level of repairs needed to restore its operability. Because the hogging air ejector is relied upon for continued secondary side heat removal and to transition the plant to cold shutdown, the staff considers this to be a potential post-fire safe shutdown vulnerability that will be evaluated further in a future NRC inspection.

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