LMS/BON/42315

2022 Inspection and Status Report for the Boiling Nuclear Superheater (BONUS) Decommissioned Reactor Site, Rincón, Puerto Rico

September 2022

U.S. DEPARTMENT OF ENERGY | Legacy Management

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Appendix A 2022 Annual Inspection Site Drawings

Abbreviations

BONUS	Boiling Nuclear Superheater
DOE	U.S. Department of Energy
LM	Office of Legacy Management
LMS	Legacy Management Support
LTS&M Plan	Long-Term Surveillance and Maintenance Plan
PL	photograph location
PREPA	Puerto Rico Electric Power Authority
RSI	RSI EnTech, LLC

Executive Summary

The Boiling Nuclear Superheater (BONUS) Decommissioned Reactor Site, on the west coast of Puerto Rico near the town of Rincón, was inspected on August 2, 2022. The inspection included checking the integrity of the entombed reactor system, containment building, site security, general housekeeping, and the condition of the surrounding land.

The integrity of the entombed reactor system was in excellent condition during this year's inspection. No cause for a follow-up inspection was identified. Puerto Rico Electric Power Authority (PREPA) personnel have done an excellent job responding to maintenance items and recommendations from previous site inspections and working through the added demands placed on the island and the operation of the BONUS facility due to coronavirus disease 2019. However, the condition of the exterior of the site remains in fair condition due to 2017 hurricane damage, mostly in the form of downed trees on the security fence. During the 2022 inspection, it was noted that the retaining wall on the west side of the property had collapsed. The repair and stabilization of this retaining wall will require action by PREPA as the site owner.

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1.0 Introduction

This report presents the findings from the U.S. Department of Energy (DOE) Office of Legacy Management (LM) inspection of the Boiling Nuclear Superheater (BONUS) Decommissioned Reactor Site near Rincón, Puerto Rico, on August 2, 2022.

RSI EnTech, LLC (RSI), the Legacy Management Support (LMS) contractor, and specifically the LMS site lead with LMS decontamination and decommissioning support staff, conducted the site inspection. The LM site manager and the RCRA/CERCLA/FUSRAP[1] team lead accompanied the inspection. Three Puerto Rico Electric Power Authority (PREPA) personnel served as escorts at the BONUS site.

The 2022 site inspection was conducted in accordance with the *Long-Term Surveillance and Maintenance Plan for the Boiling Nuclear Superheater (BONUS) Reactor Facility, Rincón, Puerto Rico* (LMS/BON/S01091), also referred to as the BONUS Long-Term Surveillance and Maintenance Plan (LTS&M Plan), and with procedures established by RSI for site inspections. The primary purpose for the inspection was to confirm the integrity of the entombed reactor and the building that contains the entombed reactor. Additional objectives included assessing site security, the general housekeeping of the site, and any changes in the surrounding area that might adversely impact the long-term sustainability of the facility.

Section 4.3 of the BONUS LTS&M Plan prescribes the LM site inspection requirements, which are described in the table below.

Inspection Requirement	BONUS LTS&M Plan Section	Status
Contact PREPA	4.3	PREPA was contacted in advance of the visit.
Contact the mayor of Rincón	4.3	The mayor was contacted in advance of the visit.
Prepare and follow an inspection checklist	4.3.1	The checklist was prepared in advance of the visit.

Before beginning the inspection, personnel reviewed and signed the job safety analysis for the site inspection at the BONUS site.

The BONUS facility consists of the containment building (which houses the entombed reactor system) and separate support buildings. PREPA uses the decommissioned BONUS facility as a museum that is open to the public for scheduled tours. Before the 2017 hurricanes, approximately five to six tours were conducted each year. Museum tours were suspended while the site was without power. Annual tour numbers have not returned to the previous levels, in part due to PREPA protocols for coronavirus disease 2019 (COVID-19) access restrictions.

DOE retains responsibility for the entombed radioactive materials that remain at the BONUS facility. In 2003, DOE conducted an Environmental Assessment and concluded that there was no unacceptable risk to human health or the environment from fixed radioactive contaminated areas. This conclusion was published in the *Finding of No Significant Impact for Authorizing the*

[1] RCRA = Resource Conservation and Recovery Act; CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; FUSRAP = Formerly Utilized Sites Remedial Action Program.

Puerto Rico Electric Power Authority (PREPA) to Allow Public Access to the Boiling Nuclear Superheat (BONUS) Reactor Building, Rincón, Puerto Rico (DOE 2003). However, there are limited and discrete areas within the museum building that have fixed residual radioactive contamination, and these areas are isolated, shielded, and posted to protect visitors and workers. Radiation surveys of the facility are conducted quarterly by PREPA staff, then annually by a third-party subcontractor. The most recent annual radiological survey was conducted in July 2022.

2.0 Inspection Results

Features discussed in this report are shown on the attached site drawings (Appendix A). Photographs to support specific observations are identified in the text and on the site drawings by photograph location (PL) numbers. Inspection items, issues, actions, observations, and recommendations for 2022 are provided in Table 1 and discussed below.

Table 1. 2022 Inspection Items, Issues, Actions, Observations, and Recommendations

No.	Item	Issue	Action	2022 Inspection Observations and Recommendations
1	Access	Site security and access accountability.	Inspectors need to sign in on the required log sheet at the security gate upon arrival.	The site security guard met the team at the access gate and the inspection team signed the required log sheet.
2	Specific site surveillance features	In addition to the information in this row, see site-specific surveillance features listed below in this table.	Inspect the following: • Roads and parking area • Entrance gate • Access through the security gate • Security fence • Retaining wall along beach • Enclosed domed building and monolith plaques	• The roads and parking area were in good shape. • The entrance gate was in good shape. • There were no issues with access through the security gate. • The security fence remains damaged from the hurricanes in 2017. It was down or heavily damaged in several areas. • The retaining wall along the beach has collapsed. • The enclosed dome and monolith plaques were in good shape. • Outdated inspection tags were observed on fire extinguishers.
3	Enclosed domed building—entombed concrete monolith and monolith penetrations	Structural defects or degradation can result in loss of containment or radioactive materials.	Inspect for possible indications of structural problems, such as cracking, staining, and spalling.	The entombed reactor system was found to be in excellent condition. No indications of structural problems, such as cracking, staining, or spalling, were identified on the entombed concrete monolith and monolith penetrations.

Table 1. 2022 Inspection Items, Issues, Actions, Observations, and Recommendations (continued)

No.	Item	Issue	Action	2022 Inspection Observations and Recommendations
4	Enclosed domed building—external piping systems	Systems were flushed during decommissioning. Incidental contamination remains, which might be released if systems corrode or otherwise fail.	Inspect for possible indications of deterioration, such as peeling and blistering paint, staining, and flaking.	External piping systems showed no signs of deterioration, such as peeling and blistering paint, staining, and flaking.
5	Enclosed domed building—basement	Some areas contain radiological contamination in excess of DOE standards; the general public is not allowed access to contaminated areas.	Note the condition of access control barricades.	Access control barricades to the basement were in place and in good order. Inspectors observed that there was a lead brick holding open a door in the basement. DOE prefers that it be placed inside the fume hood with the others as shielding.
		In November 2018, PREPA conducted a radiation survey that discovered removable contamination at the base of a condensation pump in the Condensate Pump Room of the basement. The contamination consisted of approximately two handfuls of rust debris stained with oil. It is believed that the contamination is somehow related to the 2017 storm events. Contamination was fixed in place with an epoxy material.	Observe the posting as a contamination area (rope and signage). Inspect the fixed contamination in the Condensate Pump Room.	Access to contamination was being properly managed and controlled. Postings were correct. The contamination that was fixed in place in the Condensate Pump Room with an epoxy material remains undisturbed. DOE would like PREPA to place more epoxy atop the previously elevated rust debris to strengthen the encapsulation. A small area of fluid was observed at the base of the Gen. Seal Oil Filter No. 1 in the basement of the containment building. DOE would like PREPA to further assess the radiological nature of this fluid.
		Asbestos pipe installation exists throughout the basement, but PREPA asbestos-certified personnel have inventoried the pipe installation and stabilized it in place. In accordance with the BONUS LTS&M Plan, asbestos inspections are performed quarterly and air sampling is performed annually by PREPA staff or contractors.	Visually assess piping where available. Discuss current findings from quarterly asbestos inspections and annual air samplings with PREPA personnel.	Visual assessment confirmed that asbestos continues to be managed properly (non-friable condition).
6	Enclosed domed building—basement flooding	Water accumulating in the basement might mobilize and redistribute surface contamination. The basement flooded in 1998 due to Hurricane Georges. After that flood, stormwater drains were unplugged, and the rubber door seals were replaced.	Inspect rubber door seals and stormwater drains.	No water was present on the basement floor. The basement floor was exceptionally clean.

Table 1. 2022 Inspection Items, Issues, Actions, Observations, and Recommendations (continued)

No.	Item	Issue	Action	2022 Inspection Observations and Recommendations
7	Enclosed domed building—main floor	Some areas contain radiological contamination in excess of DOE standards; the general public is not allowed access to contaminated areas.	Note the condition of access control barricades, ceramic floor tile, and lead blocks; note general housekeeping. Check to see if access to stairways leading to the basement level is being effectively maintained and controlled to keep out the public.	Access control barricades on the main floor were in place and in good order. Ceramic floor tiles and lead blocks were in good shape. General housekeeping was excellent. Stairways leading to the basement level were being effectively maintained and controlled to keep the public out. An opening in the side of Airlock 2 has what appears to be an electric cord running through it. This opening should be closed.
8	Enclosed domed building—mezzanine	Some areas contain radiological contamination in excess of DOE standards; the general public is not allowed access to contaminated areas.	Note the condition of access control to the mezzanine; note general housekeeping.	Access control barricades to the mezzanine were in place and in good order. General housekeeping was excellent.
9	Enclosed domed building—exterior	Building should appear well maintained. In 2013, the outer surface of the containment dome was repainted. In 2013, the rubber seal at the base of the containment dome was repaired.	Visually inspect the exterior of the building.	The outer surface of the dome was in excellent condition, with the exception of one small area that needs to be repainted due to hurricane damage. A secondary rubber seal installed at the base of the containment building is functioning properly but beginning to show signs of wear. Surface damage on seals appears to be caused by water ponding and evaporating. To better ensure long-term integrity of the seal, overlaps of the secondary seal should be caulked, and the ends of the seal should be better attached to the wall of the containment building dome. Some unwanted vegetation was observed growing around the base of the containment dome building. A broken handrail was observed at the entrance to the facility. What appears to be damage to the molding that connects the containment dome to the auxiliary building was observed. The molding appears to remain functional.

Table 1. 2022 Inspection Items, Issues, Actions, Observations, and Recommendations (continued)

No.	Item	Issue	Action	2022 Inspection Observations and Recommendations
10	Surrounding land	New or changing features or activities adjacent to the site can affect site security. The retaining wall located along the west side of the property (along the beach) is heavily damaged and needs to be rebuilt.	Note changes within 0.25 mile (400 meters) of the site.	The perimeter security fence is in poor condition. Trees have fallen on several areas, holes exist, and the entire fence is down in some areas. The condition of the retaining wall has significantly deteriorated since the 2019 inspection. Remaining portions are likely to fail/collapse, which presents both liability and safety concerns. The site drainage culverts were clear of debris.
11	General site upkeep	The building should appear well maintained.	Observe and evaluate changes in site conditions.	General housekeeping around the site was excellent. Areas between buildings and along the fence line were free of trash. Conditions were good with the exception of vegetation damage resulting from the 2017 hurricanes. The auditorium and patio area were in good shape and were being used by PREPA. The training center was not being used, and the interior was exposed to the elements. Ventilation and humidity levels within the containment dome and museum continue to be a challenge. Many excellent museum displays are in danger of being damaged due to the lack of better controlled temperatures and humidity levels. Some fire extinguisher inspection tags had expired. A broken handrail was present outside the entrance to the dome containment building.
12	Site security	A security guard should be stationed at all times.	Ensure that a security guard is present.	Around-the-clock site security was good, but the damaged perimeter fence was a security weakness.
13	Erosion	Ensure that hill slopes and the beach adjacent to the site are not actively eroding in a way that could adversely affect the facility.	Evaluate erosional features on the adjacent slopes and beach.	The hill slopes and beach adjacent to the site were not actively eroding in a way that could adversely affect the facility, but the condition of the barrier wall along the beach has worsened, and the wall has significantly deteriorated. This site feature may require more maintenance in the future than it has in the past due to climate change effects such as the. potential for greater frequency and intensity of tropical storms.

2.1 Containment Building and Entombed Reactor System

The containment building houses the entombed reactor system. The dome of the containment building has a diameter of approximately 160 feet and a circumference of approximately 502 feet. The entombed reactor system within the containment dome was found to be in excellent condition, and its integrity was confirmed. No indications of structural problems, such as cracking, staining, or spalling, were identified on the entombed concrete monolith and monolith penetrations. External piping systems showed no signs of deterioration, such as peeling and blistering paint, staining, and flaking.

Access control barricades in the basement, on the main floor, and on the mezzanine were in place and in good order. The basement was very clean and there was no water present on the basement floor.

A small area of fluid was observed at the base of the Gen. Seal Oil Filter No. 1 in the basement of the containment building. DOE requested that PREPA further investigate the nature of this fluid, which resembles oil (PL-1).

Inspectors observed that there was a lead brick holding open a door in the basement of the containment dome. DOE prefers that this brick be placed inside the fume hood with others as shielding.

Inspectors observed that an opening in the side of airlock 2 has what appears to be an electric cord running through it. This opening should be closed to protect the interior of the containment dome (PL-2).

The outer surface of the dome was reconditioned and painted in 2013 (PL-3). Paint in one area of the dome was damaged during the hurricane and needs to be repainted.

A rubber seal is installed around the base of the containment dome to keep water from seeping into the building. In 2010, the seal was observed to be cracked, ripped, and missing in some spots. Evidence of water seepage was observed in a few spots along the top of the basement wall inside the containment dome, which indicated that the seal was leaking in those areas. PREPA installed a secondary rubber seal over the damaged primary seal to carry water away from the underlying damaged seal. During this site inspection, inspectors noted that overlaps of the secondary seal should be caulked (PL-4) and the ends of the secondary seal need to be trimmed and better secured to the dome, perhaps using a caulking compound to prolong the life of the seal. No evidence of recent water seepage was observed along the top of the basement wall in the containment building during this year's inspection, which indicates that the secondary seal is functioning properly.

In November 2018, PREPA conducted a radiation survey and discovered removable contamination in the basement at the base of a condensation pump in the Condensate Pump Room. The contamination consisted of approximately two handfuls of rust debris stained with oil. It is believed that the presence of the rust material is somehow connected to the two hurricane storm events in 2017. The rust debris has been safely encapsulated (sealed) in an epoxy material, which was observed to be intact and undisturbed. DOE would like PREPA to place more epoxy across the top of this area to strengthen the encapsulation.

2.2 Site Security

Site security consists of a guard shack that is staffed around the clock, a motor-operated entrance gate (24 feet wide), and a security fence (i.e., a 6-foot-high chainlink fence topped with three strands of barbed wire) that encloses approximately 5 acres.

Upon arrival, the security guard was present and the gate was closed and locked. The on-duty security guard allowed the inspection team to enter the grounds. The perimeter security fence was found to be in poor condition. Numerous downed trees resulting from the 2017 hurricanes damaged the fence in several areas (PL-5, PL-6, PL-7). The fence is entirely down in some areas (PL-8). For security purposes, the fence needs to be repaired as soon as possible.

The barrier wall along the beach on the west side of the property (and the security fence that was installed along the top of the wall) are significantly deteriorated (PL-9 and PL-10). The steep hillside and dense vegetation will discourage trespass, but this area is no longer secured by a perimeter fence.

2.3 Support Facilities

Support facilities (auditorium, patio area, and training center) are on the west side of the property. The support buildings have no effect on the integrity of the containment building entombment but were inspected to get a better understanding of their present condition and potential future use.

The auditorium was in good condition and was being used by PREPA. It consists of a stage area with seating for approximately 100. The patio area is just outside of the auditorium. It was in good condition and was also being used by PREPA on an as-needed basis. The training center was not being used. For safety reasons, the inspection team did not go inside the training center.

2.4 General Housekeeping

General housekeeping around the site was excellent. Areas between buildings and along the fence line were free of trash. Except for vegetation damage from the 2017 hurricanes, the landscaping was well maintained. Inspectors observed that some fire extinguishers had expired (PL-11).

Ventilation and humidity levels within the containment building continue to be a challenge. Many of the excellent museum displays were showing wear due to poor ventilation and humidity. Many of the exhibits are in danger of being permanently damaged if conditions are not improved.

2.5 Surrounding Area

The retaining wall on the west side of the facility, near the beach, has significantly deteriorated since the 2019 inspection. Storm drains leading from the site were found to be clear and free of debris. The beach west of the facility is readily utilized by the public (PL-12).

3.0 Recommendations

The following recommendations are made for the site.

One small area of the dome should be repainted to help protect the dome from corrosion.

All fire extinguishers should be inspected.

To better ensure the long-term integrity of the secondary rubber seal at the base of the containment dome, overlaps of the seal should be caulked, and the ends should be better attached to the wall of the building.

Unwanted vegetation around the base of the containment building should be sprayed.

It needs to be confirmed that the unknown oily substance at the base of the Gen. Seal Oil Filter No. 1 is merely oil that has leaked to the floor.

The elevated material that was fixed in place in the Condensate Pump Room with an epoxy material remains undisturbed. DOE would like PREPA to place more epoxy across the top of the material to further strengthen the encapsulation.

Hurricane damage to the perimeter fence and the retaining wall along the beach should be repaired.

The opening in Airlock 2 should be closed.

4.0 Photographs

PL Number	Azimuth	Photograph Description
PL-1	—	Fluid Noted at Base of Gen Seal Oil Filter No. 1
PL-2	0	Opening to Outside in Airlock 2
PL-3	60	Containment Dome
PL-4	—	Gap in Seal at Base of Dome
PL-5	120	Damaged Perimeter Fence
PL-6	90	Damaged Perimeter Fence
PL-7	210	Tree Down on Perimeter Fence
PL-8	90	Damaged Beach Barrier Wall and Downed Security Fence
PL-9	90	Damaged Beach Barrier Wall
PL-10	90	Damaged Beach Barrier Wall
PL-11	60	Expired Fire Extinguisher Inspection Card
PL-12	—	View from Lighthouse, Horses on Beach

Note:
— = Photograph taken vertically from above.

PL-1. Oily Substance Noted at Base of Gen Seal Oil Filter No. 1

PL-2. Opening to Outside in Airlock 2

PL-3. Containment Dome

PL-4. Gap in Seal at Base of Dome

PL-5. Damaged Perimeter Fence

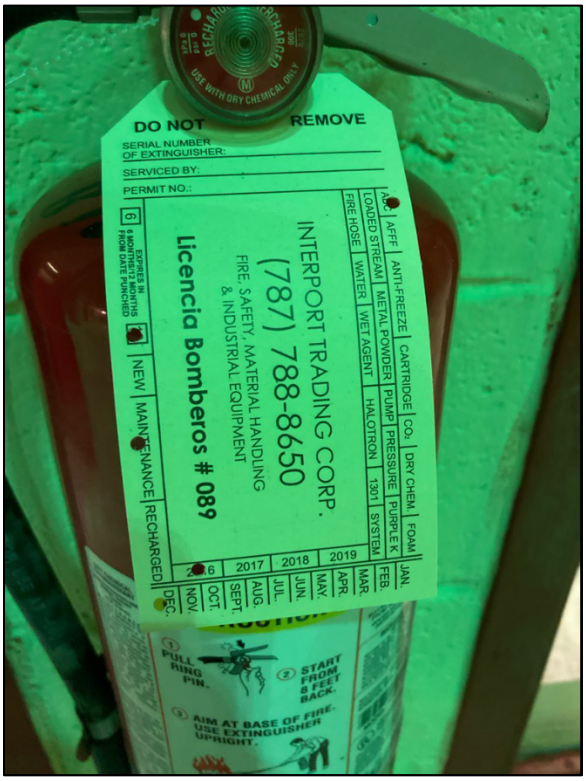
PL-6. Damaged Perimeter Fence

PL-7. Tree Down on Perimeter Fence

PL-8. Damaged Beach Barrier Wall and Downed Security Fence

PL-9. Damaged Beach Barrier Wall

PL-10. Damaged Beach Barrier Wall



PL-11. Expired Fire Extinguisher Inspection Card

PL-12. View from Lighthouse, Horses on Beach

5.0 References

DOE (U.S. Department of Energy), 2003. *Finding of No Significant Impact for Authorizing the Puerto Rico Electric Power Authority (PREPA) to Allow Public Access to the Boiling Nuclear Superheat (BONUS) Reactor Building, Rincón, Puerto Rico,* FONSI DOE/EA-1394, Oak Ridge Operations Office, January.

Long-Term Surveillance and Maintenance Plan for the Boiling Nuclear Superheater (BONUS) Reactor Facility, Rincón, Puerto Rico, LMS/BON/S01091, continually updated, prepared by the LMS contractor for the U.S. Department of Energy Office of Legacy Management.

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Appendix A

2022 Annual Inspection Site Drawings

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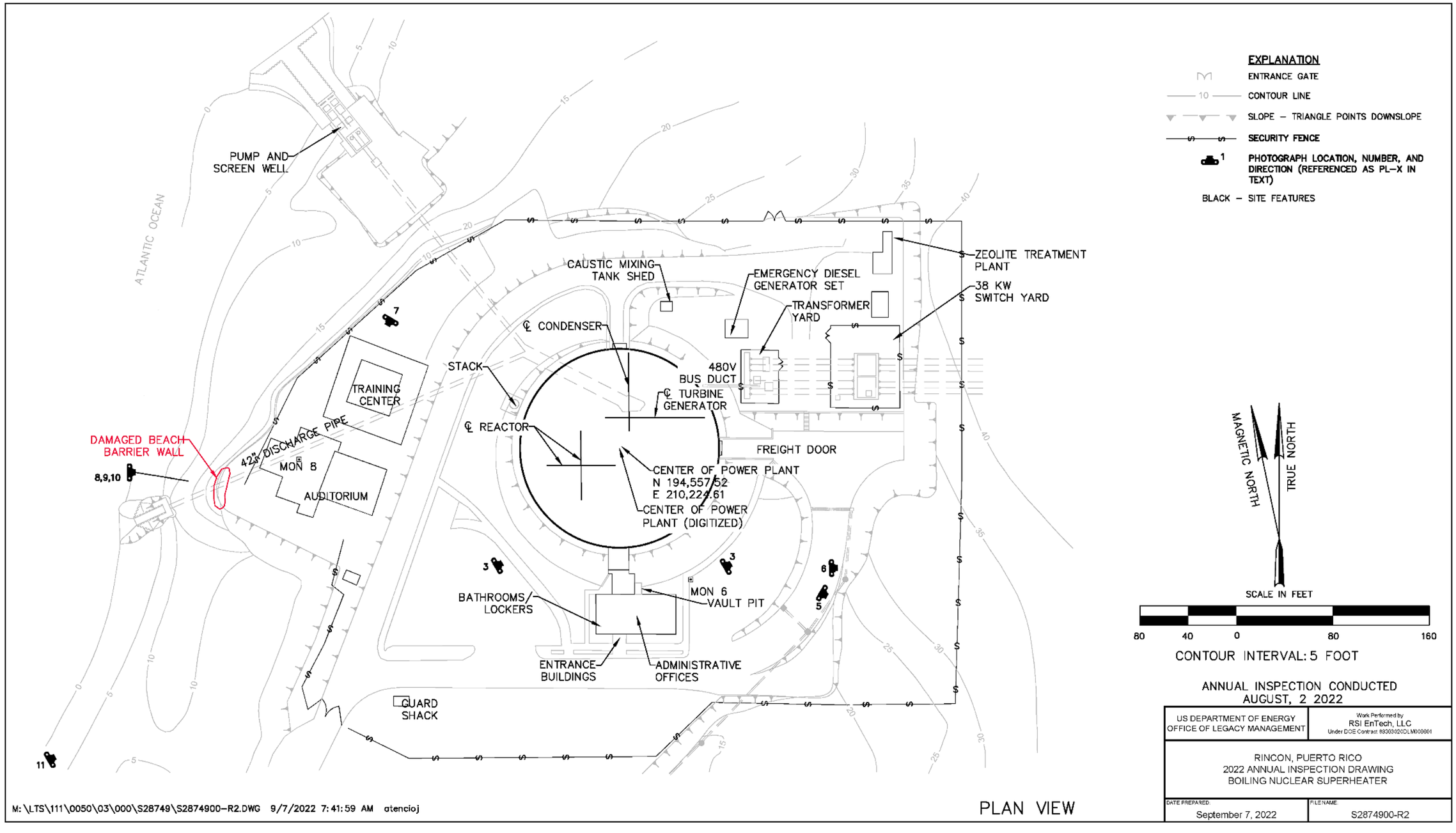

Figure A-1. 2022 Annual Inspection Drawing, Plan View, Rincón, Puerto Rico, BONUS Site

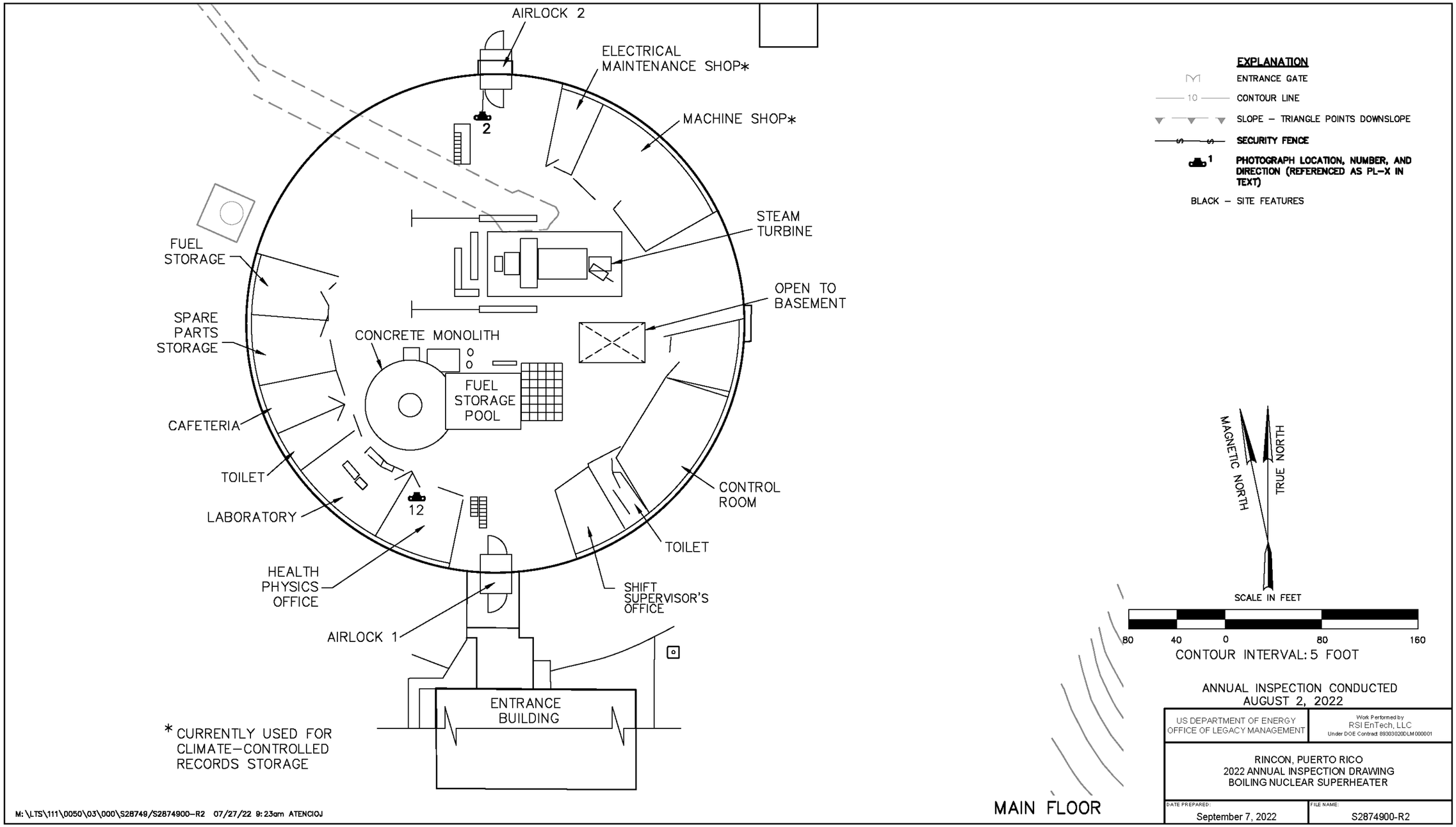

Figure A-2. 2022 Annual Inspection Drawing, Main Floor, Rincón, Puerto Rico, BONUS Site

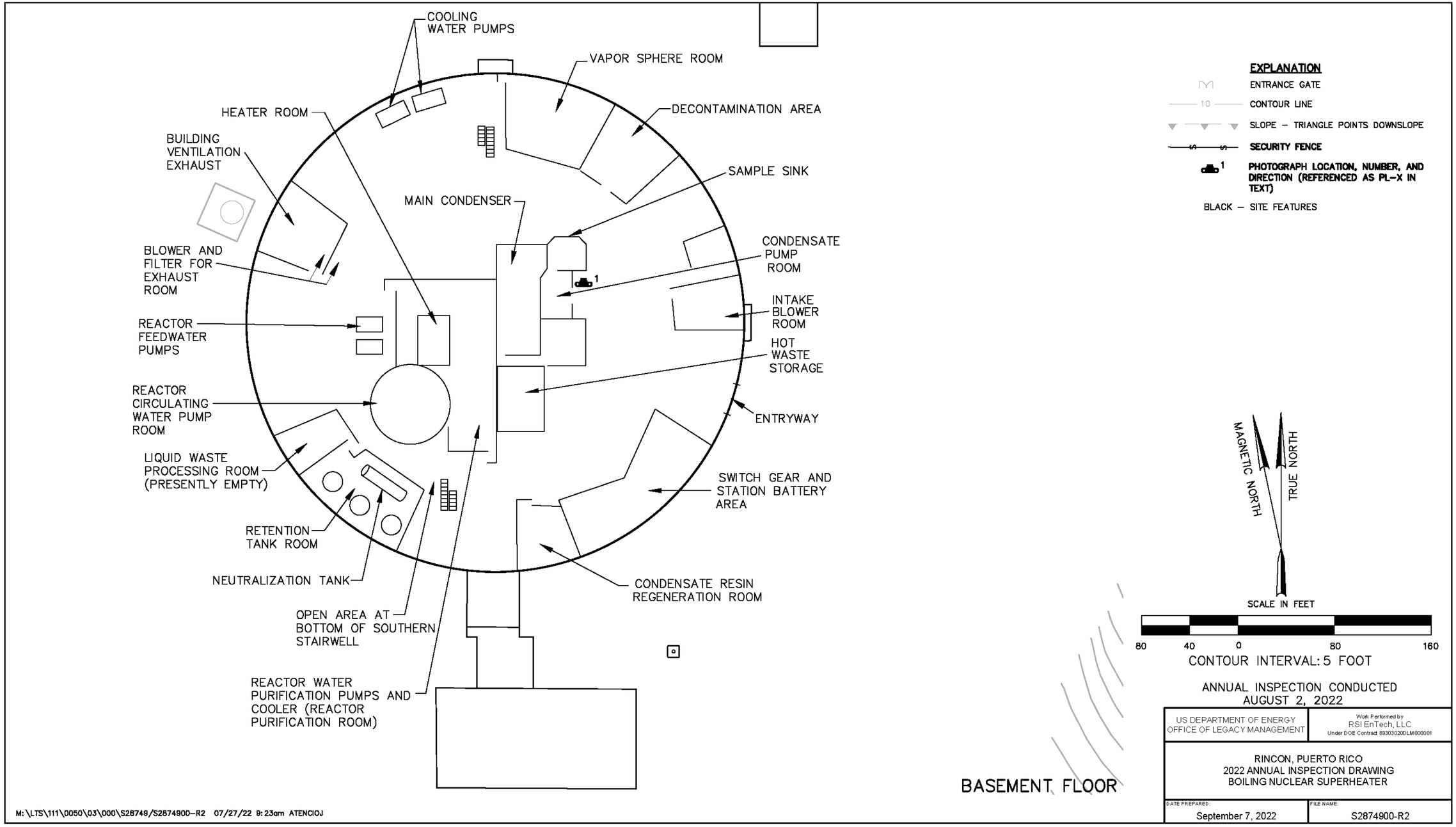

Figure A-3. 2022 Annual Inspection Drawing, Basement Floor, Rincón, Puerto Rico, BONUS Site

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