# RADIOLOGICAL HISTORICAL SITE ASSESSMENT

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Reviewed by Steve Bump, CHP, CIH, PMP
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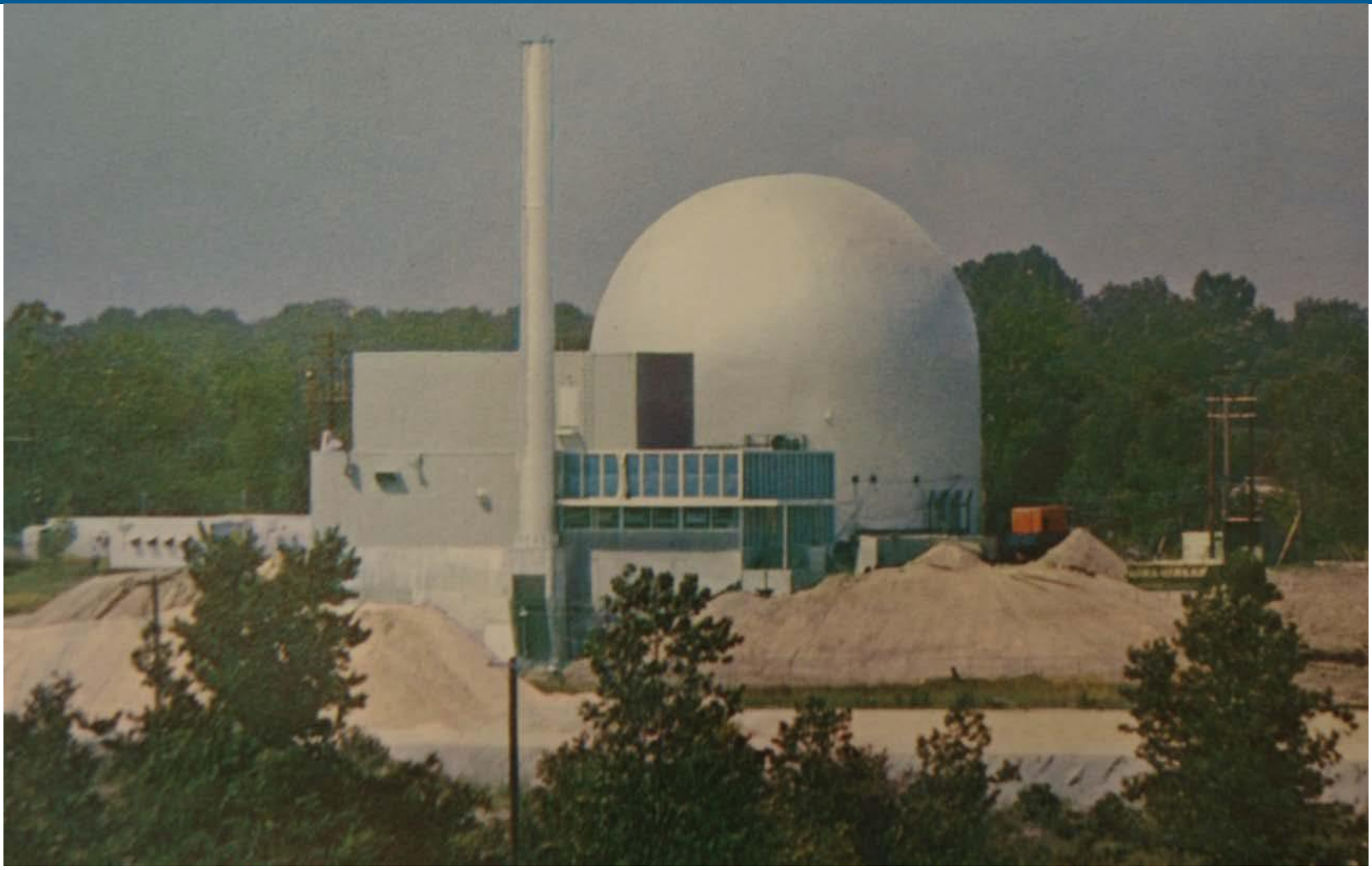
Prepared For:

**Auxano / Piqua Facility**



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**DMA-TR-106 Radiological Historical Site Assessment for Auxano / Piqua Facility**

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ALARA | As Low as Reasonably Achievable |
| Bgs | Below Ground Surface |
| CS/CSP | Characterization Survey / Characterization Survey Plan |
| FSS | Final Status Survey |
| HSA | Radiological Historical Site Assessment |
| MARSSIM | ***Multi-Agency Radiation Survey and Site Investigation Manual***, NUREG-1575 |
| NEPA | National Environmental Policy Act |
| PNPF | Piqua Nuclear Power Facility |
| RSO | Radiation Safety Officer |
| SP | Survey Plan |
| SU | Survey Unit |

# 1.0 INTRODUCTION

This HSA pertains to specifically licensed radioactive materials used in the Piqua Nuclear Power Facility, PNPF, located at the southeastern edge of the city of Piqua, Ohio, at 123 Bridge Street. The decommissioned PNPF building and the auxiliary building are owned by the Department of Energy, and leased to the city of Piqua.

The PNPF initiated operation in June 1963, with final shutdown in January of 1966. The facility was decommissioned in 1967-1969 with the nuclear fuel, coolant, and much of the highly radioactive material removed from the facility. The remaining radioactive material was sealed within the reactor vessel/bioshield. There are no known fuel failures or significant releases noted in any operational reports or other documents. Limits on radioactive materials remaining on site were based on the ICRP limits and models for internal doses which are limited to 10% of the occupational dose at that time, and at 0.2 mrem/hr for external doses, as found in 10 CFR 20 at the time of decommissioning (AEC-12832). The allowable limits for free release at the current time are found in DOE Order 458.1 and associated documents or in 10 CFR 835 and are lower than the limits in place at the time of decommissioning (DOE O 458.1, 10 CFR 835 Appendix D).

The preferred purpose of this project is to develop a design for the demolition/construction activities required to demolish the structures at the Decommissioned Reactor Site in Piqua, OH, while maintaining protectiveness of the entombed radioactive material. This preferred alternative could be modified, based on State Historic Preservation Act findings. This would leave some land use, and digging restrictions.

The building could be considered historic which could preclude demolishing the exterior of the structures. This alternative could include doing nothing to the building but internal modifications to maintain and increase safety and security to the structures and entombed radioactive material. All current restrictions would likely remain in place along with the requirements for ongoing monitoring.

The last alternative addresses the potential for removal of all the auxiliary buildings, all of the containment, and all of the reactor vessel/bio-shield. This option could result in the removal of all restrictions and the facilities being released for unrestricted or unlimited use.

Other alternatives could be considered during National Environmental Policy Act (NEPA) evaluation, such as partial demolition or re-purposing for a different land use, but the three options delineated above would encompass these alternatives.

This HSA is intended to support the preferred purpose alternative and will address Classification, Characterization Survey and ultimately the Final Status Survey (FSS) that is being performed as part of facility disposition. This HSA generally reflects the format recommended in MARSSIM (NUREG-1575).

# 2.0 PURPOSE OF THE HISTORICAL SITE ASSESSMENT

This HSA presents information concerning radioactive materials management and control in the PNPF for the purpose of radiological disposition. Information gathered during the HSA process is intended to identify any needed Characterization Survey (CS) necessary to fill data gaps and support the Final Status Survey report (FSS), which will contain the determination of whether the facility could be released for unrestricted use. This HSA will define the classification of the facility rooms and areas. This HSA will also identify the appropriate decision-making authority for questions regarding release of the Facility for unrestricted use.

## 2.1 CLASSIFICATION OF SURVEY UNITS FOR RELEASE FOR UNRESTRICED USE

DOE is the release agent for radioactive materials that could remain from this Atomic Energy Commission-era reactor. Survey Units (SU) is used in MARSSIM terminology for contiguous or similar areas that fall under one classification and can be represented in one survey. The allowable limits for free release, or release for unrestricted use, at the current time are found in DOE Order 458.1 and associated documents or in 10 CFR 835 and are lower than the limits in place at the time of decommissioning. Free release of the facility, outside of the entombment foot print, would mean that all radiological controls would be removed from that area (DOE O 458.1, 10 CFR 835 Appendix D).

## 2.2 CLASSIFICATION OF SURVEY UNITS FOR MARSSIM IMPACT DESIGNATION

The classification of Survey Units in a typical MARSSIM decommissioning project identifies Survey Units as Impacted or Non-Impacted as follows:

- Non-Impacted – no radiological impact from site operations, e.g. residential or other buildings that have not contained radioactive materials or have only contained license-exempt radioactive materials such as smoke detectors.
- Impacted – areas with some potential for residual contamination and/or activation.
    - Class 1 areas – these areas have potential or known contamination above the release criteria, e.g. locations where leaks or spills are known to have occurred, former burial or disposal sites, waste storage sites, areas previously subjected to remedial actions;
    - Class 2 areas – these areas have a potential for radioactive contamination or known contamination, but are not expected to exceed the release criteria, e.g. locations where radioactive materials were present in an unsealed form, upper walls and ceilings of buildings or rooms subjected to airborne radioactivity, areas on the perimeter of former contamination control areas; and
    - Class 3 areas – these areas are not expected to contain any residual radioactivity, or a small fraction of the release criterion, based on site operating history and previous radiological surveys.

The impact designation is then used to determine the percent of the surface area that is subject to scanning surveys and surface activity measurements. Class 1 areas have the greatest potential for contamination and, therefore, receive the highest degree of survey effort, followed by Class 2 and then Class 3 areas (NUREG-1575).

The preliminary classification of the PNPF decommissioned reactor building, and the basement of the auxiliary building is Impacted – Class 1. The auxiliary building interior rooms immediately adjacent to airlock entries to the containment have a preliminary classification of Impacted – Class 2. The remainder of the auxiliary building has a preliminary classification of Impacted – Class 3. The final Class will be determined after further investigation and surveys.

# 3.0 PROPERTY IDENTIFICATION AND PHYSICAL SETTING

The PNPF is located at the southeastern edge of the city, on the east bank of the Miami River in Piqua, OH, at 123 Bridge Street. It consists of the reactor building and an auxiliary building connected by an air lock. The reactor building is approximately 120 feet from the river's edge. Access to the site is over an improved road which also provides access to the Piqua Sewage Treatment Plant, operated by the City of Piqua, which is also the closest occupied building and is about 200 feet away. The nearest residence is about 750 feet west (AI-AEC-MEMO-12708).

Piqua is characterized by a continental-type climate with about 35 inches of rain per year, with high relative humidity most of the time. Rainfall occurs approximately 130 days per year. Average tornado frequency for Ohio is 3.2 events per year. The seasonal average temperatures range from 31 °F and 73 °F with extremes at -14 °F and 106 °F (AI-AEC-MEMO-12708).

To date there has never been earthquake damage in Piqua, which is designated as Seismic Zone 2 by the Uniform Building Code based of historical earthquakes in western Ohio (AI-AEC-MEMO-12708, USGS websearch 2019).

Piqua is near the center of the Miami River Valley, a nearly flat plain 8 to 19 miles across and 50 to 100 feet below the general elevation of the adjacent terrain. The Miami River originates 40 miles northeast of the Piqua and flows southerly around the eastern fringes of the city. The Miami River drains into the Ohio River 90 miles south of Piqua. Flood control of the Miami River has been effective with the highest elevation during flood flows of 857.4 feet above sea level. The arbitrary 100-foot level of the reactor building corresponds to 866 feet above sea level (AI-AEC-MEMO-12708).

Soils at the reactor site show alluvial soil and rock to a depth of 8 feet, limestone of the Brassfield form to 30 feet, blue weathered shale and fossiliferous limestone of the Richmond form to 50 feet, and hard impervious bedrock over 50 feet. Groundwater in the region collects mostly in the weathered layer of the shale, which is located above the hard bedrock. Most wells in the region are drilled to this layer. The natural drainage of water from this layer is to surface streams (AI-AEC-MEMO-12708).

There is one domestic well located 0.15 mile west of the site across the Great Miami River. There are four domestic wells that sit 0.3 to 0.6 mile east of the site. Groundwater flows in a westerly direction toward the Great Miami River, see Figure 3-1. The well depths range from 54 to 118 feet below ground surface (bgs).

Ohio Water Wells


Figure 3-1

The reactor building is a vertical cylindrical steel containment with a domed top. This building contained a prototype organic cooled and moderated 45.5 megawatt thermal reactor, the steam generating equipment, and the heat transfer system. The attached auxiliary building contained the coolant purification and radioactive waste systems in the basement, auxiliary equipment such as HVAC, offices, and the control room on the remaining floors (AEC-12832). The exterior of the reactor building is protected from contact with the soil by a bitumastic coating. A cathodic protection system was employed to reduce the corrosive attack on the steel shell (AI-AEC-MEMO-12708), but fell into inoperative condition in the last few years. (Current Project Personnel) Even with the inoperative cathodic protection system, the bitumastic coating would still provide a measure of protection to the reactor vessel/bio-shield.

Three pipelines, approximately 1,400 feet in length, connected the PNPF on the east side of the Great Miami River and the Municipal Power Plant on the west side of the river. These three lines included: (1) a 12-inch diameter steam line for steam flow from the PNPF steam generator to the conventional power plant steam header. This line also provided preheat and start-up steam from the conventional plant to the PNPF, (2) a 6-inch diameter line for boiler feed-water supply from the conventional plant to the PNPF, and (3) a 3-inch line for the return of process steam condensate from the PNPF to the conventional plant (SEC-00126). These lines exited the PNPF underground to an underground utility vault on the north side of the site, proceeding underground to the bank of the river, and then continued above ground beneath the walking bridge across the river and above ground to the generating facility (discussions with Present Project Personnel).

# 4.0 HISTORICAL SITE ASSESSMENT METHODOLOGY

This section describes the preliminary steps of the HSA, how the HSA was conducted, and what sources of information were used.

## 4.1 IDENTIFICATION OF TEAM MEMBERS

The author of this HSA was Clark Barton, CHP. This HSA was reviewed by Stephen Bump, CHP, project manager for NV5.

## 4.2 PRELIMINARY HSA INVESTIGATION AND MARSSIM QUESTIONS USED

Section 3.4 of MARSSIM (NUREG-1575) recommends that a limited-scope investigation be conducted to collect readily available information and provide initial classification of the two onsite buildings as Impacted or Non-Impacted. The MARSSIM-recommended twenty questions and answers for the PNPF are provided in Table 1; they serve as the preliminary step in the historical review.

*Table 1. MARSSIM Historical Site Assessment Questions*

| MARSSIM Question: | Response: |
|---|---|
| 1. Was the site ever licensed for the manufacture, use, or distribution of radioactive materials under Agreement State Regulations, NRC licenses, or Armed Services permits, or for the use of 91B material? | Yes |
| 2. Did the site ever have permits to dispose of, or incinerate, radioactive material onsite? Is there evidence of such activities? | Yes |
| 3. Has the site ever had deep wells for injection or permits for such? | No |
| 4. Did the site ever have permits to perform research with radiation generating devices or radioactive materials except medical and dental x-ray machines? | Yes |
| 5. As part of the site's radioactive materials license, were there ever any soil moisture density gauges or radioactive thickness monitoring gauges stored or disposed of onsite? | No |
| 6. Was the site used to create radioactive materials by activation? | Yes |
| 7. Were radioactive sources stored at this site? | Yes |
| 8. Is there evidence that the site was involved in the Manhattan Project or any Manhattan Engineering District (MED) activities (1945-1946)? | No |
| 9. Was the site ever involved in the support of nuclear weapons testing (1945- | No |

| MARSSIM Question: | Response: |
|---|---|
| 1962)? | |
| 10. Were any facilities on the site used as a nuclear weapons storage area? Was weapons maintenance ever performed at the site? | No |
| 11. Was there ever any decontamination, maintenance or storage of radioactively contaminated ships, vehicles, or planes performed onsite? | No |
| 12. Is there a record of any aircraft accident at or near the site (e.g., depleted uranium counterbalances, thorium alloys, radium dials)? | No |
| 13. Was there ever any radiopharmaceutical manufacturing, storage, transfer, or disposal onsite? | No |
| 14. Was animal research ever performed at the site? | No |
| 15. Were uranium, thorium, or radium compounds (NORM) used in manufacturing, research, or testing at the site, or were these compounds stored at the site? | Yes |
| 16. Has the site ever been involved in the processing or production of NORM or mining, milling, processing, or production of uranium? | No |
| 17. Were coal or coal products used onsite? If yes, did combustion of these substances leave ash or ash residues onsite? | No |
| 18. Was there ever any onsite disposal of material known to be high in NORM (e.g., monazite sands used in sandblasting)? | No |
| 19. Did the site process pipe from the oil and gas industries? | No |
| 20. Is there any reason to expect that the site may be contaminated with radioactive material (other than previously listed)? | Yes |

Seven of the MARSSIM questions were answered in the affirmative; thus, portions of the PNPF are presumed to be impacted. The rational for each positive answer is:

Question 1, yes, a reactor operated at the site, with the associated fuel, activation products, fission products, startup sources, and instrumentation sources would have been present.

Question 2, yes, it is well documented that spent coolant was held for decay and then burnt onsite.

Question 4, yes, part of the facility mission was to perform experiments with organic cooled reactor and fuel.

Question 6, yes, an operating reactor causes activation products.

Question 7, yes, startup sources and instrumentation sources would have been at the site.

Question 15, yes, uranium was the main component of the fuel, and was a minor contaminate in the aluminum alloy cladding.

Question 20, yes, the reactor was defueled and decommissioned, during which components were likely size reduced for shipping which could have introduced reactor internal activation products into the entire containment.

## 4.3 LICENSE AND COMPLIANCE INSPECTION

PNPF was an operating nuclear reactor from 1963 to 1966 operated under agreement with the AEC. After decommissioning, where most highly radioactive materials were removed and the majority of remaining materials were sealed in the reactor vessel/bio-shield. The building remained the property of the AEC, succeeded by the DOE, and was leased to the city of Piqua (DOE S0007600).

Several safeguards were in place to ensure that radioactive materials contained within the reactor vessel/bioshield did not escape into the buildings or surrounding areas and periodic surveys were conducted to show that surface contamination levels did not increase (DOE S0007600).

The only noted area of fixed contamination, a single floor drain in the lowest level of the reactor building, has decayed from approximately 7000 dpm/100 $cm^2$ after decommissioning (AEC-12832) to approximately 650 dpm/100 $cm^2$ in 2019 (RSN 190328-001). Based off of the values on several different annual surveys of the elevated location, it appears that the half-life of the contamination is approximately 5 years, which is consistent with an assumption that it is mainly Cobalt–60.

Special surveys were conducted in 2019 prior to removal of asbestos coverings on water and steam pipes in the facility. No contamination was found (LMS Rad Survey Water and Steam). The available surveys show the status of the areas where they were taken, but may not meet the requirements of MARSSIM. They have been used for preliminary classification and will be considered when characterization surveys are planned.

## 4.4 DOCUMENTS REVIEWED

This HSA was prepared using the following resources:

- Review of available documents from the operating and decommissioning period of the PNPF; and
- Discussions with the present personnel involved with the PNPF.

The reference section lists documents that were directly used in this HSA, but in many cases there were other documents reviewed with similar information that are not listed since only one document was necessary to reference the information.

## 4.5 SITE BOUNDARIES

The site is located in southwestern Ohio (north of Dayton) on the east bank of the Great Miami River in the southeastern portion of the town of Piqua, Ohio (Figure 4-1). It is situated on DOE-owned land about 900 feet southeast of the Piqua Municipal Power Plant and about 150 feet north of the City Sewage Treatment Plant. The north and east sides of the decommissioned facility are bounded by a limestone quarry owned by the Armco Steel Company. The site is approximately 120 feet from the Great Miami River (LMS/PIA/S00076-1.0).

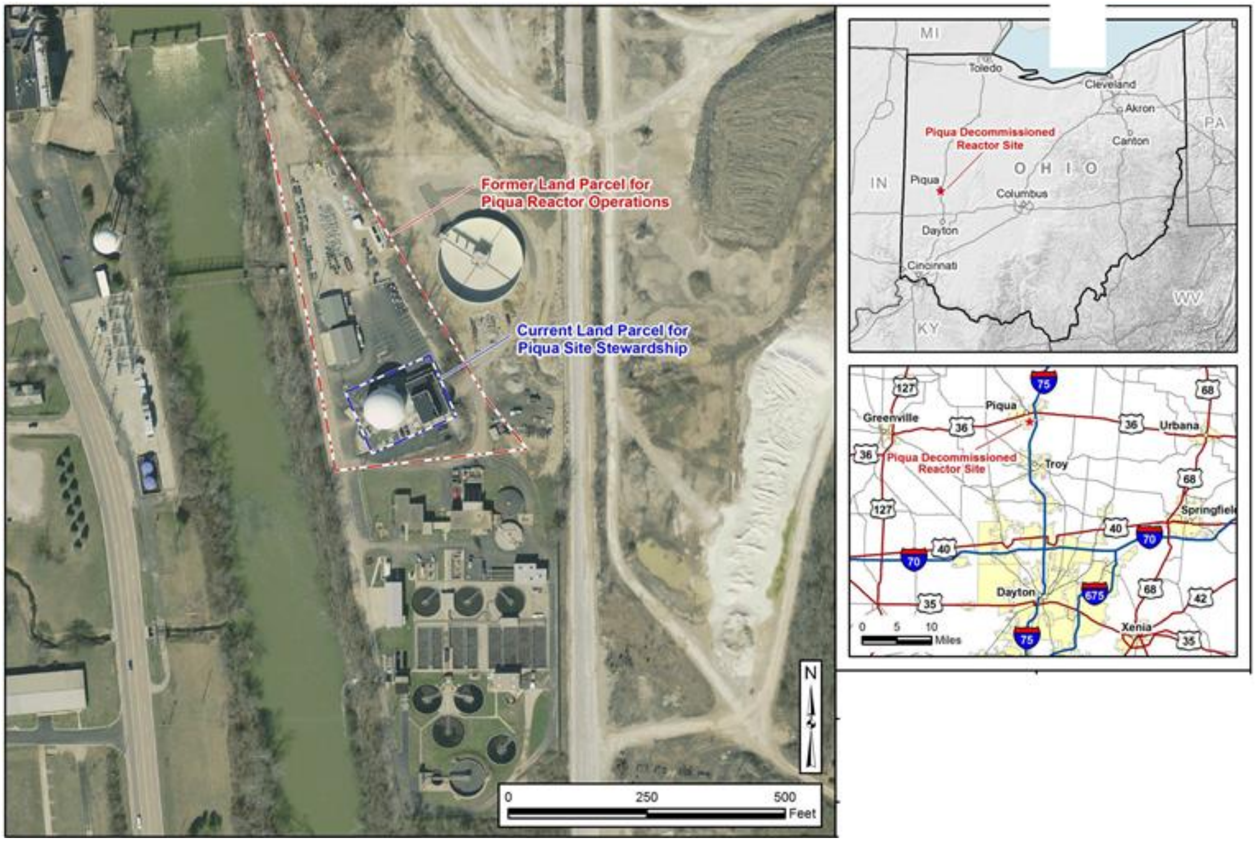


Figure 4-1

## 4.6 APPROACH AND RATIONALE

As stated in earlier sections, the purpose of this HSA is to identify existing data and information about the site and facilities, and identify any data gaps that need to be filled with a Characterization Survey to support a Final Status Survey that supports a decision on the radiological release of the facilities to the extent possible. The site has a preponderance of documentation on the site, the facilities and historical use of the facilities. There are annual surveys of the reactor building, showing that the originally selected survey points, selected at the time of decommissioning, have not increased.

The existing data is sufficient to show that the pre-selected points have not increased, and that the one point with elevated activity has decayed with an approximate 5 year half-life, consistent with Cobalt-60. This is sufficient to develop initial classification levels for areas of the facility consistent with the MARSSIM definitions:

- Class 1 Areas: Areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiation surveys) above the $DCGL_W$.

  Examples of Class 1 areas include:

  1) site areas previously subjected to remedial actions[3],
  2) locations where leaks or spills are known to have occurred,
  3) former burial or disposal sites,
  4) waste storage sites, and
  5) areas with contaminants in discrete solid pieces of material and high specific activity.

- Class 2 Areas: Areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the $DCGL_W$. To justify changing the classification from Class 1 to Class 2, there should be measurement data that provides a high degree of confidence that no individual measurement would exceed the $DCGL_W$. Other justifications for reclassifying an area as Class 2 may be appropriate based on site-specific considerations.

  Examples of areas that might be classified as Class 2 for the final status survey include:

  1) locations where radioactive materials were present in an unsealed form,
  2) potentially contaminated transport routes,
  3) areas downwind from stack release points,
  4) upper walls and ceilings of buildings or rooms subjected to airborne radioactivity,
  5) areas handling low concentrations of radioactive materials, and
  6) areas on the perimeter of former contamination control areas.

- Class 3 Areas: Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the $DCGL_W$, based on site operating history and previous radiation surveys. Examples of areas that might be classified as Class 3 include buffer zones around Class 1 or Class 2 areas, and areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification.

Class 1 areas have the greatest potential for contamination and therefore receive the highest degree of survey effort for the final status survey using a graded approach, followed by Class 2, and then by Class 3. Non-impacted areas do not receive any level of survey coverage because they have no potential for residual contamination. Non-impacted areas are determined on a site-specific basis. Examples of areas that would be non-impacted rather than impacted usually include residential or other buildings that have or had nothing more than smoke detectors or exit signs with sealed radioactive sources (NUREG-1575).

The preliminary classification of the PNPF decommissioned reactor building, and the basement of the auxiliary building is Impacted – Class 1. The auxiliary building interior rooms immediately adjacent to airlock entries to the containment have a preliminary classification of Impacted – Class 2. The remainder of the auxiliary building has a preliminary classification of Impacted – Class 3. The final Class will be determined after further investigation and surveys.

# 5.0 HISTORY AND CURRENT USAGE

This section provides a history of radioactive materials usage at PNPF, given the preliminary information in Section 1 of this report, and a review of surveillance activities at PNPF. Available radioactive materials program records were reviewed. Use of radioactive materials was authorized as incidental to nuclear reactor operation.

## 5.1 HISTORY AND TIMELINE

A summary of the PNPF operating history is shown in Table 5-1. This table was taken from the SEC-00126 document, which has an in-depth discussion of the site, the facilities, and the history of the site.

**Table 5-1: Summary of PNPF Operating History**

| Date | Action |
|---|---|
| June 1963 | Initially criticality achieved. |
| July 1963 | Fuel loading completed. |
| January 27, 1964 | Full power achieved; reactor operated steadily but with one scram. |
| May 21, 1964 | First scheduled shutdown for routine maintenance and inspection<br><br>During this period of operation, POMR contributed ~ 40% of the energy generated by the City of Piqua. |
| December 7, 1964 | Reactor was shut down to renew fifteen in-vessel filters and remove the fuel element in Core position F-13 for examination. |
| January 28, 1965 | Reactor was shut down for complete replacement of in-vessel filters, maintenance, and for relocation of the instrumented fuel element from position E-12 to position D-5. |
| April 2, 1965 | Several malfunctioning control rod drive units repaired.<br><br>Concern over possible plugged condition of the inner process tube of the control rod-bearing elements led to the movement of the six inner ring control rod elements to peripheral positions. The core size was increased from 61- 67 fuel elements. |

| | |
|---|---|
| May 6 – 12, 1965 | Scram occurred on May 6, 1965. During this time, the reactor coolant level had been lowered by operational error, which resulted in a temporary loss of circulation through three elements.<br><br>Shutdown was extended until May 12 so the three fuel elements could be removed to spent-fuel storage. |
| May 13, 1965 (estimated date) | Immediately upon restart, excessive surface temperatures were noted, necessitating additional fuel element removal.<br><br>Because of the fuel element removal, the system operated with only one coolant pump during the latter half of June and into July. |
| July 18, 1965 | Reactor shut down for modifications, maintenance, and in-vessel filter replacement; performed extensive modifications of the in-core control rod circuitry. |
| September 6, 1965 | Reactor operation resumed. |
| October 12, 1965 | Reactor shut down, fuel rearrangements were made, increasing the core loading to 70 fuel elements. |
| October 23, 1965 | Reactor restarted. Operation of the reactor continued at an average power level of about 24 MWt. |
| January 13, 1966 | Reactor scrammed because of a spurious signal. At this time, there was no indication of any unusual condition in the reactor core. Prior to restarting the reactor, an abnormal in-core condition was identified during the performance of a rod-drop test.<br><br>**Note: The reactor was shut down sometime after the abnormal in-core condition.** |

After the shutdown, plans were made, and carried out, to decommission the facility by removing reactor fuel and core components, organic coolant drained, and materials shipped off site or burned in accordance with approved procedures. These actions started in December 1967, including removal of all systems other than the fire protection, ventilation, air cooler, lighting, sump pump, sump alarm, and cathodic protection systems. Most highly radioactive materials were shipped offsite for burial, with some lower activity materials being relocated into the reactor vessel and entombed in place with the un-removable activated reactor vessel and bioshield. Surveys at the end of decommissioning showed little contamination other than the drain at the F4 area on the 56 foot level (AEC-12832). It is unclear if the steam lines were removed or abandoned in place, but this will be investigated as part of the CSP.

At the end of the decommissioning in 1969, AEC and the City signed a long-term lease agreement that leases the site to the City at no cost. In accordance with the lease, the City is responsible for facility maintenance and upkeep, including maintaining a cathodic protection system and water level alarm for a sump pump. LM holds the title to the facility and 0.457 acre of land and is responsible for ensuring the protectiveness of the radiological materials entombed onsite. As conveyed in the lease agreement, the title will revert back to the City when the entombed materials reach levels for safe release through natural decay processes, which is estimated to occur in the year 2106 (LMS/PIQ/S18928-0.0).

From 1969 until the late 2010's the city of Piqua used the Auxiliary Building and parts of the Reactor Building for storage of electrical and underground utility materials as well as office and meeting spaces. Through discussions with 2019 site support personnel, it was obvious that both the Cathodic Protection and Sump systems were not kept in working condition; however it was not deduced exactly when the systems went out of service.

In addition, the City of Piqua Police department used the 79 foot floor of the Auxiliary Building for the storage of documents, ammunition, and tactical munitions and breaching explosives as shown in Figure 5-1. Small arms and associated ammunitions were stored in the OAP room, and tactical breaching explosives were stored in ATF-approved Type-2 magazines in B-1. These munitions were determined to have no potential impact to the entombment (LMS/PIQ/S13153). Room B-4 was used for vehicle storage, B-6 for chain of custody evidence, and B-7 & B-8 for general storage (discussions with Present Project Personnel).

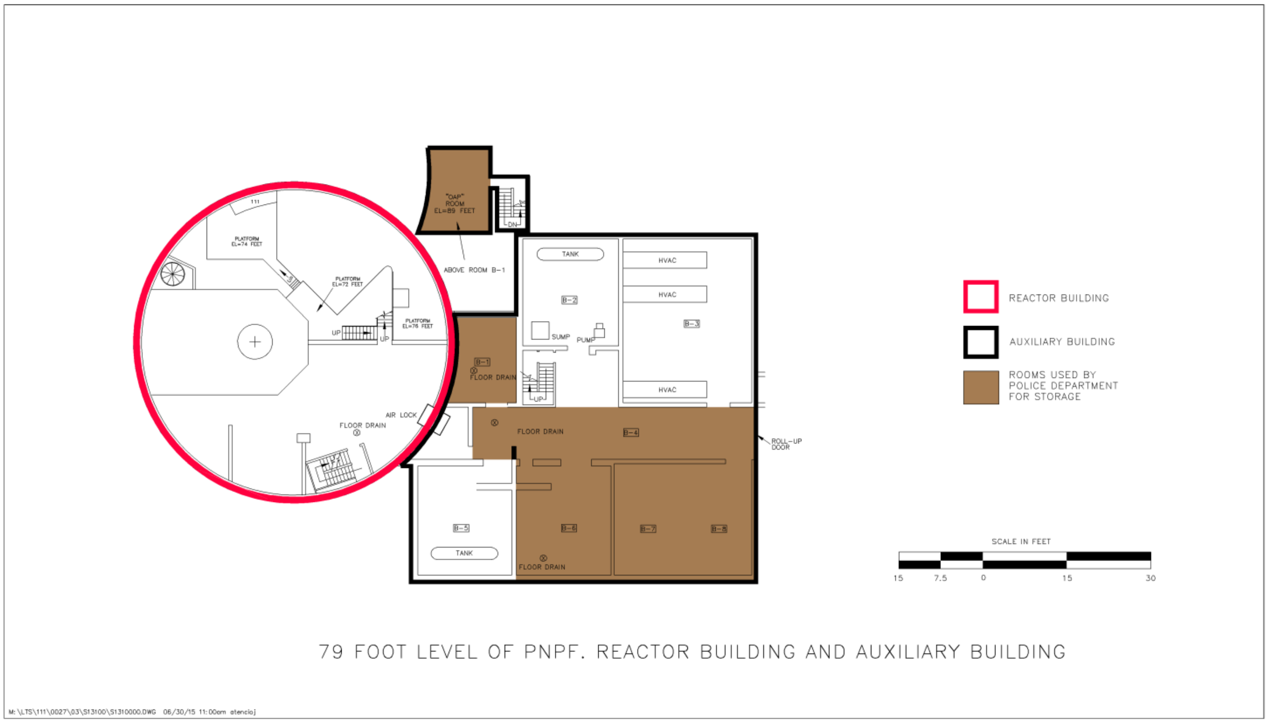


Figure 5-1 Layout of Areas Used by Piqua Police

## 5.2 USE AREAS

Radioactive material was used or stored in many locations, in addition to the materials used in the reactor and the radioactive materials resulting from activation both in the reactor and in the moderating/cooling material circulated from the reactor to the steam generators, and the coolant removed and stored for decay in the auxiliary basement. Reactor operation ceased in January 1966, and decommissioning was completed in 1969. At that time, the facility was in a generally clean condition with no significant contamination in normally occupied areas. The higher level radioactive materials were removed, most of the remaining radioactive materials, along with the unremovable components of the reactor framing and the inner 2 to 3 feet of the bioshield which was activated, were all sealed in the reactor vessel/bioshield (AEC-12832). There is no evidence that there was ever contamination outside the PNPF or that the ground water was ever impacted or would be impacted (LMS/PIA/S00076-1.0).

The PNPF was surveyed after decommissioning, which showed very little contamination, and was periodically re-surveyed in the same locations to show that conditions have not changed (AEC-12832, many annual survey/inspection reports).

### 5.3 NUCLIDES OF INTEREST

As an operating nuclear reactor, the core contained fissionable material, primarily isotopes of uranium. As operations continued, other isotopes would be generated both from the fission process and from neutron capture. The range of nuclides possible would be very large, however the decommissioning process and surveys indicate that only some activation products are likely, with the most predominate from a dose rate standpoint for the long term being Cobalt-60 (half-life 5.26 years) and Silver-108m (half-life 418 years). Calcium-45 was the most significant at the time of decommissioning, but with a half-life of 163 days is no longer a great concern. Iron-55 was also prevalent at the time of decommissioning, but again a relatively short half-life of 2.75 years means that it has decayed away in the 53 years that has elapsed. Nickel-63 is present, and with a half-life of 101 years it will be present for a very long time, but only has very weak beta emissions (AEC-12832).

There still exists the possibility of some source or fuel material being present, which along with the potential for fission and activation products means potential contamination would include both alpha and beta activity. Characterization and Final Status Surveys should consider both alpha and beta emitters, including low energy beta emitters.

## 6.0 EVALUATION OF HISTORICAL SITE ASSESSMENT DATA

According to MARSSIM Section 3.6.2, Impacted Areas have a potential for radioactive contamination, based on historical data, or contain known radioactive contamination based on past or preliminary radiological surveillance. This includes areas where: (1) radioactive materials were used and stored; (2) records indicate spills, discharges, or other unusual occurrences that could result in the spread of contamination; (3) radioactive materials were buried or disposed, or (4) areas that underwent remediation. Areas immediately surrounding or adjacent to these locations are included in this classification because of the potential for inadvertent spread of contamination.

Non-impacted areas – identified through knowledge of site history or previous survey information – are those areas where there is no reasonable possibility for residual radioactive contamination.

### 6.1 POTENTIALLY CONTAMINATED AREAS

The entire PNPF reactor building and the basement of the auxiliary building where the radioactive waste and decay tanks were located, as well as any piping that may have contained steam generated using coolant from the reactor and tanks that may have contained reactor related fluids, are considered to be Impacted – Class 1 since an operating nuclear reactor, with the associated radioactive fuel, fission products, activation products, and other radioactive materials were the primary focus of the decommissioning process.

The airlocks and the areas in the auxiliary building immediately adjacent to the airlock entries into the reactor building, and any onsite underground utility vault areas that may have contained steam piping, will be considered Impacted – Class 2 since the definition of Class 2 includes areas on the perimeter of Class 1 areas.

The remainder of the auxiliary building will be considered Class 3. The above grade ground level outdoors including the outer surfaces of the reactor containment building and the auxiliary building will be considered Class 3. Areas outside of the current PNPF land will be considered Non-Impacted.

# 7.0 DATA QUALITY OBJECTIVES FOR THE HSA

According to MARSSIM, three HSA data quality objectives (DQO) results are expected:

- Identifying an individual or a list of planning team members – including the decision maker. The "decision maker" is the leader of the planning team, the person with the most authority over the study, who assigns roles and responsibilities to planning team members.
    - For this project, the decision maker is Stephen Bump, NV5 Project Manager.
    - The planning team members consist of the author of this report, Clark Barton, CHP and Stephen Bump, CHP, NV5 Project Manager.
- Concisely describing the problem. The problem or situation description provides background information on the fundamental issue to be addressed by the assessment.
    - Radioactive materials were present in the PNPF. The preparation of an HSA and SP and the execution of Characterization Surveys and FSS were authorized to identify the presence of any radioactive contamination, if present.
    - The intention is to:
        1. Confirm that the existing radiological conditions meet the proposed classifications, or provide the knowledge necessary to re-classify the facilities,
        2. Confirm that surface contamination found in all areas after a FSS are below the applicable release limits, and
        3. Verify, based on a satisfactory outcome of items 1 and 2 above, that the PNPF facilities could be released for unrestricted use if complete remediation is performed, or that the area defined outside the entombment could be released for unrestricted use if entombment remains.
    - The DOE is the release authority and must be satisfied with the FSS results.
- Initially classifying the building as Impacted or Non-Impacted.

# 8.0 CONCLUSIONS AND RECOMMENDATIONS

This HSA identifies the past and potentially current presence of radioactive materials at the PNPF.

The remaining steps in the process to radiologically decommission the PNPF under the provisions of DOE regulations are to:

- Complete a Characterization Survey Plan outlining the survey requirements;
- Conduct a Characterization Survey of the PNPF facilities. The Characterization Survey will identify any residual radioactive material and verify the initial classifications;

- Complete a Survey Plan outlining the survey requirements when facility final condition is achieved;
- Conduct a Final Status Survey of the PNPF, either the existing configuration or the footprint after complete dismantlement, or somewhere in between. The FSS will identify any residual radioactive material and what, if any, impact there is for unrestricted release; and
- Prepare the report for the PNPF facilities outlining the FSS findings and submit the FSS report to the DOE for review. If the DOE is satisfied with the FSS report, they can disposition the facility.

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Revision History

*Table 2. Revision history of this document*

| Revision | Performed by | Date and Time | Comment |
|---|---|---|---|
| 1.0 | Clark Barton | November 8th, 2019 1:18 PM | Creation |
| 1.1 | Kelci Barton | November 9th, 2019 1:48 PM | Technical editing; small changes to format and language |
| 1.2 | Clark Barton | December 3rd, 2019 4:29 PM | Comment Resolution |
| 1.3 | Clark Barton | January 2, 2020 8:45 AM | Comment Resolution |
| 1.4 | Clark Barton | January 6, 2020 4:01 PM | Comment Resolution |
| 1.5 | Clark Barton | January 14, 2020 12:49 PM | Comment Resolution |

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