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Document Title:
107-F Retention Basin Stabilization (Phase I) Decommissioning Phase Report

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Decontamination & Decommissioning

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Abstract

The purpose of this report is to discuss and document the significant activities relating to the Phase I decommissioning of the 107-F Retention Basin. Phase I decommissioning involved successfully demolishing the concrete walls and component structures of the 107-F Retention Basin and burying the concrete rubble. These tasks were accomplished by Westinghouse Hanford Company in FY 1987. This work prepares the basin for the establishment of a protective barrier and site restoration, Phase II, thus completing Phase I decommissioning of this facility.

This report covers the demolition of the structure and the stabilization of the rubble in situ within the boundaries of the original structure. All work on this project was performed by Hanford Decontamination and Decommissioning forces. Phase I work was started in June 1987 and was completed in August 1987.

The 107-F Retention Basin was built in 1943 and was in service between 1945 and 1965. The basin is a rectangular, concrete-lined, open-topped reservoir with a volume of 80,000 cubic yards. The vertical walls are reinforced concrete construction with a minimum thickness of 1 ft at the top and 5.75 ft at the bottom. The basin, located between the reactor and the river, was used to hold up effluent reactor coolant water to allow thermal decay and radioactive decay of short-lived activation and fission products before returning the water to the Columbia River. Phase I included demolition of the outlet distribution structure, concrete walls/flume, effluent components, and covering the rubble with one foot of clean fill for interim stabilization.

The 107-F Retention Basin Phase I project proceeded on schedule and also underran budgeted costs by using efficient and effective concrete demolition techniques learned on the five previous basins interim stabilization projects.

The issuance of this report completes Phase I work. The basin is now ready for Phase II decommissioning engineering and planning activities which will ultimately decommission the basin.

Phase II plans are tentative until appropriate NEPA documentation is completed.

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1.0 INTRODUCTION

This report documents the Phase I decommissioning work on the 107-F Retention Basin completed during FY 1987. Located east of the 105-F Reactor Building, the basin was used to hold up effluent reactor coolant water long enough to permit thermal and radioactive decay of short-lived activation products before returning the water to the river.

The scope of the 107-F Retention Basin decommissioning work included:

- Planning and Engineering (including preparation of the Decommissioning Project Readiness Review (DPRR) which authorized work to proceed on June 12, 1987.
- Radiological surveys and sampling.
- Site preparation.
- Demolition of the inlet/outlet distribution structure and the basin exterior/divider walls.
- Stabilization of the rubble with a cover of at least 1 ft of clean fill for temporary stabilization of residual contamination. This 1 ft of clean fill will provide an interim stabilization of the basin while waiting for Phase II work to commence.
- Phase Report

The decommissioning work is scheduled in two phases. Phase II plans are tentative until NEPA documentation is completed. It is anticipated that Phase II decommissioning will complete the final effort as follows:

- Provide clean backfill/barrier as determined by Allowable Residual Contamination Level (ARCL) calculations, and perform final grading to prevent ponding and to match existing terrain.
- Facility Decommissioning Report

The basin is located in the 100-F Area on the Hanford Site in the State of Washington, and is being decommissioned as part of the long range strategy for disposition of the shut-down 100 Area facilities.

These phases are in line with the Hanford Decontamination and Decommissioning Department main objective, which is to decommission all of the shut-down 100 Area facilities in the safest and most cost-effective way possible.

The 100 Area Environmental Protection Department prepared an Environmental Evaluation and a Safety Hazard Assessment for the 107-F Retention Basin preparation work. No adverse environmental impacts were identified in

relation to this work. No asbestos or other hazardous materials were found during this phase of the work. The hazard class was determined to be "low".

2.0 DESCRIPTION OF FACILITY

2.1 History

The 107-F Retention Basin was constructed and shut down concurrent with its associated 105-F Reactor. This reactor is one of five shut-down reactor sites that were constructed solely for the production of plutonium. The initial startup of the reactor was on February 25, 1945. The final shut-down for the 105-F Reactor occurred on June 25, 1965. Shortly after this the instrument room and masonry baffle walls were knocked into the basin and the basin was partially backfilled with clean earth to prevent the spread of residual radionuclides.

The 107-F basin, located between the reactor and the river, was used to hold up reactor cooling water long enough to permit thermal decay and radioactive decay of short-lived activation and fission products before the water was returned to the Columbia River. The reactor, ancillaries, and effluent systems have been maintained in a retired mode for about 22 years.

2.2 Location

The 107-F Retention Basin is located in the 100-F Area. This site is located along the south shore of the Columbia River where it traverses the northern part of the Hanford Site in Washington State (Figure 1). The 100-F Area is approximately 35 river miles upstream and 32 road miles from the city of Richland (Figure 2). The basin is located approximately 1,700 ft east of the 105-F Reactor Building. The site boundaries of the 100-F Area, and the location of the 107-F Retention Basin within the site, are shown on the map in Figure 3. The Hanford Site coordinates* at the southwest corner of the basin are W29130, N79500 and may be found on drawing number M-1600-F, Sheet 5.

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* The Hanford Site coordinates can be converted to United States Geodetic Survey (USGS)/(Washington State/Lambert) coordinates with the following:

$N_L = 405{,}302.04 - W_H \text{ SIN} + N_H \text{ COS}$

$E_L = 2{,}295{,}325{,}01 - W_H \text{ COS} - N_H \text{ SIN}$

N_H = Northing on Hanford Plant Grid
W_H = Westing on Hanford Plant Grid
N_L = Northing on Washington State Grid
E_L = Easting on Washington State Grid

The accuracy using the above equations is not presently defined. The accuracy of the equations shall be determined prior to use in the field.

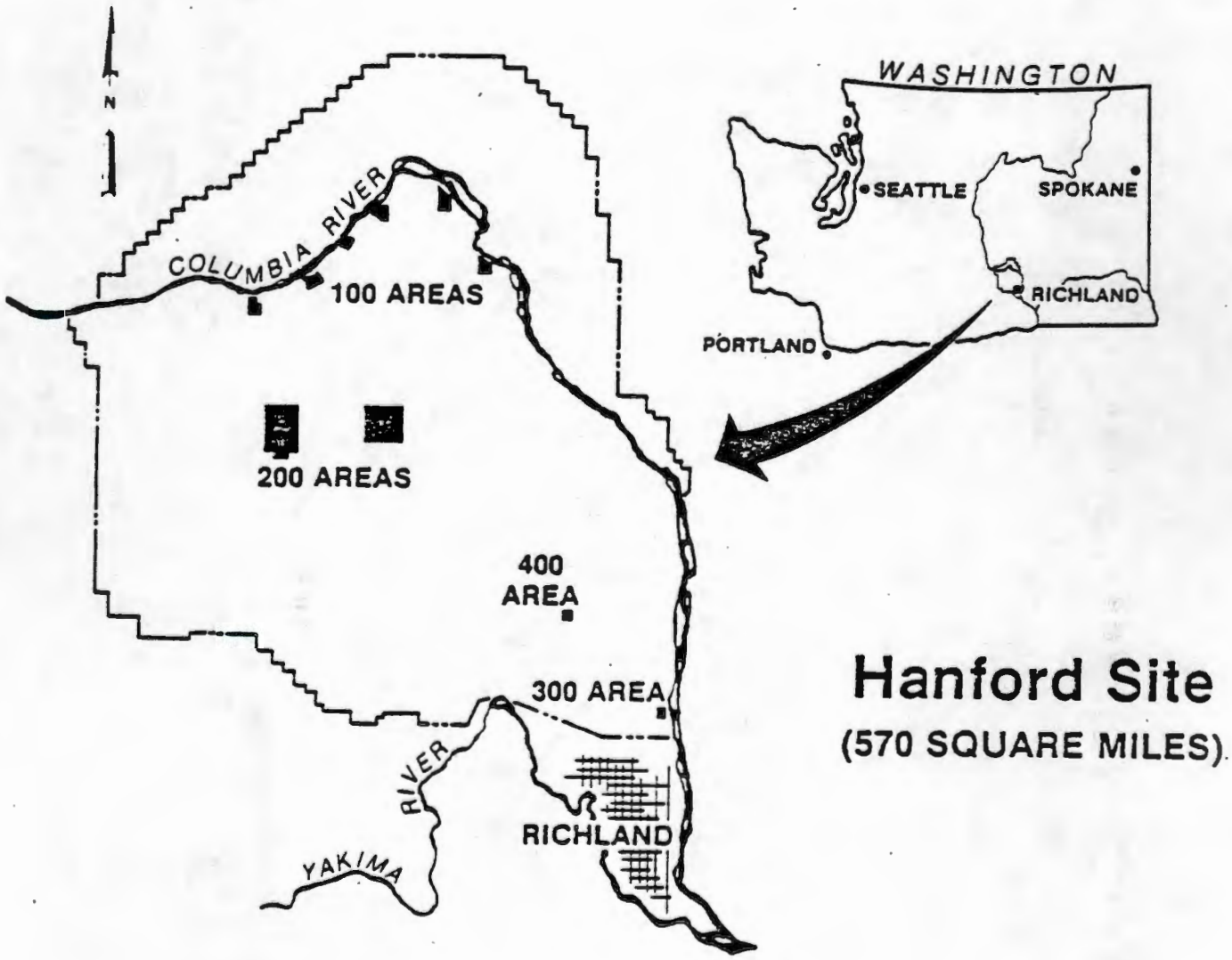

Figure 1. Location of Hanford Site

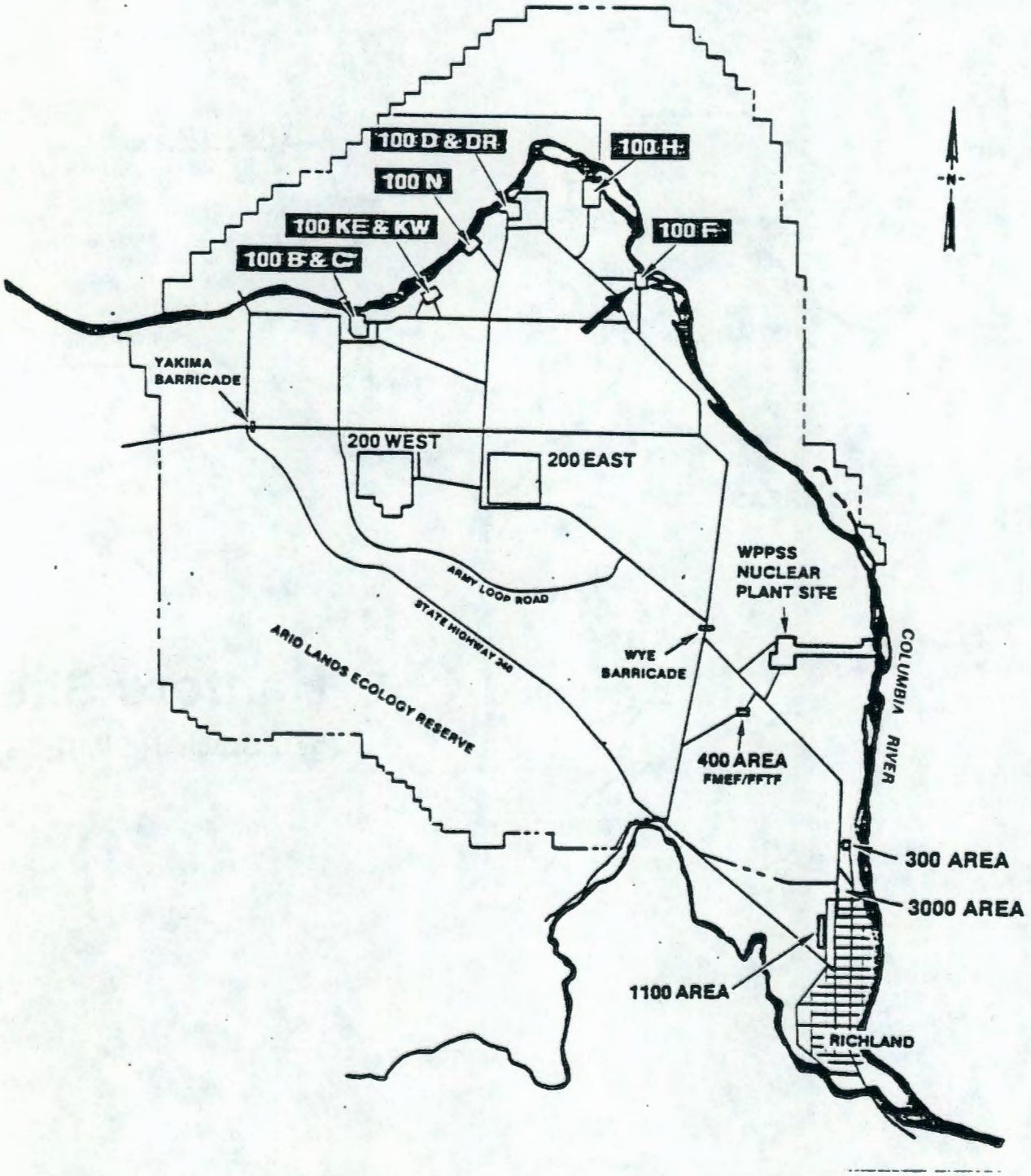

Figure 2. Hanford 100 Area Site Map

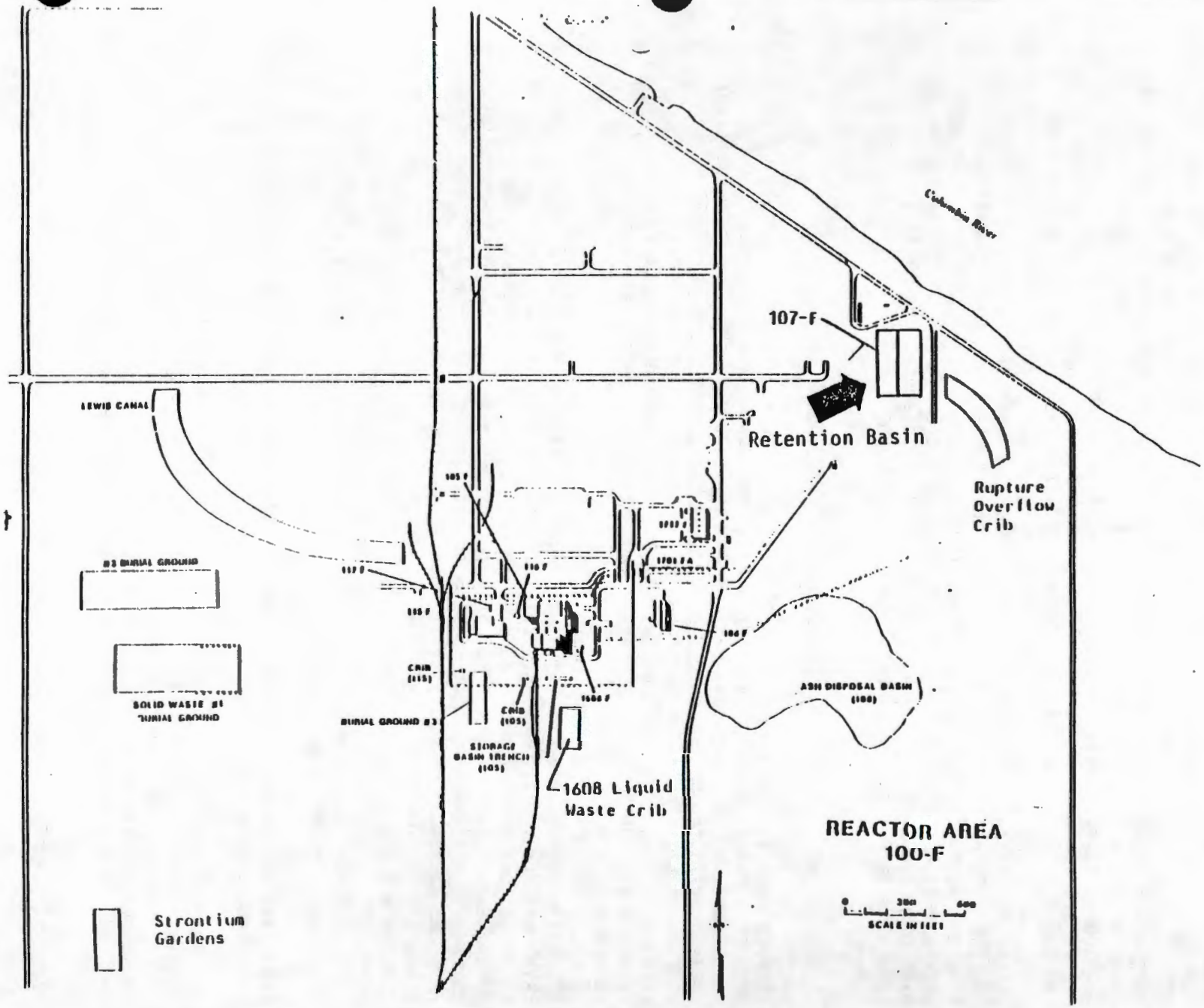

Figure 3. 100-F Reactor Area

2.3 Physical Description

The 107-F Retention Basin is a rectangular concrete reservoir 230 ft wide by 467 ft long and approximately 17 ft deep (Figure 4). A flume is located lengthwise in the middle of the basin. The floor of the basin is flat sloping up at an angle of 26 degrees to a point 10 ft above the floor slab. The sloping wall sections are 4 in. thick concrete slabs and the vertical walls are reinforced concrete construction with a minimum thickness of 1 ft at the top and 5.75 ft at the bottom. The basin walls are covered with backfill all around with the exception of the inlet chamber and effluent line inlet located at the south end. The inlet chamber, valve, and effluent pipe were dismantled per DWP-107-F-1 (December 22, 1983) and the debris along with the effluent line are stored in the basin. There were approximately 50 sections of capped effluent pipe stored in the east bay that were transferred to the west bay as part of Phase I work. The large pipe is 60 in. diameter and 30 ft in length (approximately 5 tons/section). (See Figure 5 and 6.)

3.0 ADMINISTRATIVE CONTROLS

The project was planned and accomplished prior to and after consolidation of the pre-consolidation UNC Nuclear Industries/Rockwell Hanford Company D&D Department with Westinghouse Hanford Company takeover. Project Management was delineated in the Decommissioning Services Management Guide, UNI-3073 (Reference 1). The guide describes the decommissioning organization, responsibilities, relevant documents, and other related aspects to decommission the 100 Area shut-down facilities in a safe cost-effective manner.

A detailed Work Breakdown Structure (WBS) and Task/Work Packages were developed for the project, so that all incurred project costs could be monitored and controlled. The requirements of UNC's Cost/Schedule Control System as outlined in UNI-M-109, Rev 1 (Reference 2) and the requirements of Rockwell's Management Control System as outlined in RHO-GM-MA-2 (Reference 3) were implemented. These systems aided in monitoring the project.

The project progress was tracked and reported/monitored through weekly highlights, monthly status reports, and monthly schedule statusing. Weekly scheduled meetings were held as required to discuss problem areas, progress, and assign action item responsibilities.

3.1 Dose Assessment Using Allowable Residual Contamination Levels (ARCL) Methodology

A dose assessment for determining environmental impact will be made prior to final disposition of the facility. Radionuclide inventories in the basin will be determined from sampling and isotopic analyses. A summary of the final radiological characterization is to be included in the Facility Decommissioning Report upon completing Phase II decommissioning.

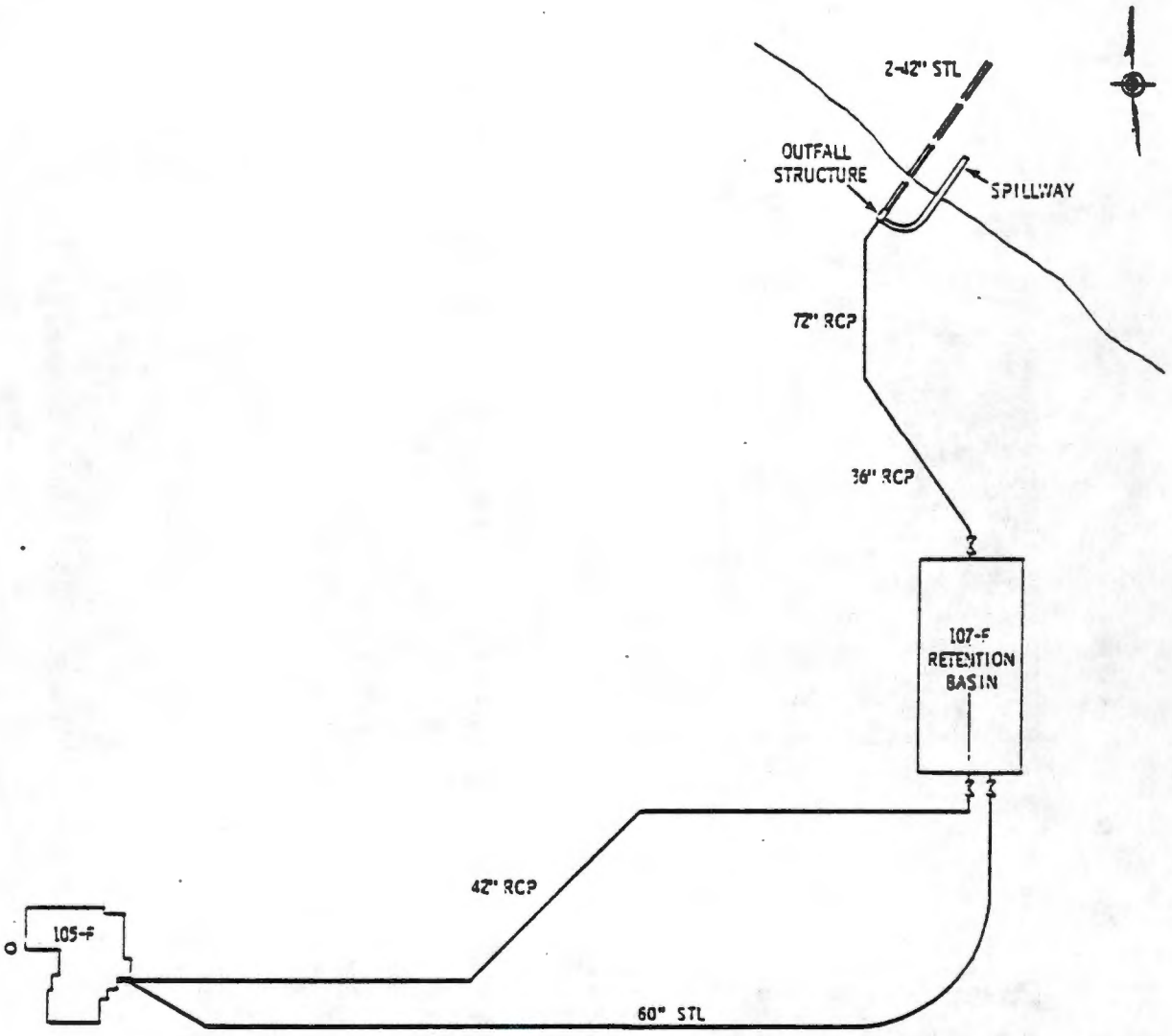

Figure 4. Reactor Retention Basin System, F Reactor

Figure 5. 107-F Retention Basin Before Phase I (North View)

Figure 6. 107-F Retention Basin After Phase I (North View)

3.2 Project Readiness Review

The Project Readiness Review (Reference 6) is a consolidation of decommissioning documents, each of which is directed towards a particular aspect of industrial, radiological, environmental, and occupational safety. Table 1 lists the documents in the Project Readiness Report and describes the primary functions.

4.0 MATERIAL CHARACTERIZATION

4.1 Hazardous Materials

A sampling of material both inside and adjacent to the 107-F Basin was accomplished in June 1987 prior to starting the Phase I stabilization work. The samples are primarily being analyzed for chemical waste inventory based on chemicals added to the reactor coolant water (sodium dichromate, sulfamic acid, and sulfuric acid) and for concentrations of heavy metals. Recent analyses of effluent sludge originating from the 1608-DR and -H Lift Station sumps showed significant concentrations of two heavy metals (Cr and Pb). Analyses of sludge from the 1608-F sumps, however, determined that concentrations of heavy metals were below regulatory limits (Letter, BJ Carlson to SJ Joncus, dated May 20, 1987 and reply June 3, 1987, "Sludge Characterization for 1608-F"). The results of chemical and radiological (see 4.2) analyses from the 107-F basin will determine the course of remedial action in Phase II decommissioning.

4.2 Radiological

Generally, the radiation and contamination levels within the facility were low enough to pose no significant problems to decommissioning personnel. The majority of the radioactive material is in the sludge on the basin floor which has an earth covering. Based on current available data, total activity in, below, and around the 107-F and other 107 basins is typically about 64 curies each. Table 2 shows a typical basin radionuclide inventory.

4.2.1 Dose Assessment

The dose assessment for Phase II decommissioning will be based on calculations of the source term present in the concrete surfaces, on the miscellaneous equipment and debris, and in the sludge and soil within the worst case hectare area encompassing the 107-F Facility. The radionuclide inventories in the facility will be determined from sampling and isotopic analysis, and from previously collected data in UNI-946 (Reference 7).

TABLE 1

DOCUMENTS IN THE PROJECT READINESS REPORT

DOCUMENT	ISSUING RESPONSIBILITY	PURPOSE
Environmental Evaluation	Environmental Safety	Describes environmental impact of proposed decommissioning work. Fulfills DOE-RL requirement for implementing NEPA process.
Safety Hazard Assessment	Environmental Safety	The Safety Hazard Assessment is a systematic investigation of three categories of hazards associated with the project: industrial, radiological and environmental. Based on hazard severity and risk, a hazard class of high, medium, or low is assigned to each project.
Decommissioning Work Procedure	Decommissioning Engineering	Describes D&D step-by-step procedures and equipment required for each phase of the project work.
Radiation Work Procedures	Radiation and Water Quality Control	Identifies the specific procedures required to ensure protection against unacceptable exposure to radiation.
Dose Assessment (Phase II)	Decommissioning Engineering	Projects post-decommissioning radiological doses based on radiological inventories and pathway analyses.
Summary and Detailed Check-lists	Decommissioning Engineering and Operations	Ensures that all cognizant departments have completed all necessary planning and procurement.
Job Safety Analysis	Decommissioning Engineering and Occupational Safety	Identifies radiological and industrial hazards and describes required precautions.

TABLE 2

INVENTORY OF RADIONUCLIDES IN THE SLUDGE OF A TYPICAL 107 RETENTION BASIN

NOTE: Typical inventory for one of eight retention basins. Radiological data calculated for March 1, 1985.

Radionuclide	Half-Life (yr)	Inventory (Ci)
3H	12.33	0.05
14C	5,780	0.3
60Co	5.27	6
63Ni	100	36
90Sr	29	0.5
137Cs	30.17	0.4
152Eu	13.4	15
154Eu	8.2	6
155Eu	4.76	0.34
238U+D	1,500,000	0.003
238Pu	87.74	0.003
239/240Pu	24,110	0.09

Typical Retention Basin Total Ci Inventory ~ 64

1 Estimate based on available data.

The Allowable Residual Contamination Level (ARCL) (Reference 5) dose assessment methodology assumes that the entire hectare source term is known. Since the source term in the hectare surrounding this facility is unknown, the dose assessment for this facility will be evaluated by anticipating the impact on future decommissioning projects. DOE guidelines state that the annual whole-body or organ dose to an individual living on the site at the time the site is released shall be less than 25 mrem/yr. Since the final dose assessment value is based on the source term contained within the surrounding hectare, the final hectare dose assessment must be less than 25 mrem/yr at the time the site is released. If a substantial source term exists at other sites within this hectare, the costs of decommissioning these sites could be substantial if the decommissioning alternatives were overly restrictive due to the overall hectare source term. Therefore, the source term introduced into a hectare from a given decommissioning project needs to be carefully evaluated. Details of the final radiological characterization will be included in the Dose Assessment Report before completing Phase II decommissioning.

If the radiological analysis meets the ARCL criteria, all the resident radioactive material will be disposed of in situ. If the dose rates cannot be met, either the sludge will be removed and prepared for disposal or some other remedial action may be required.

4.2.2 Radiological Description

Radiation and Water Quality Control (now Operational Health Physics) provided constant monitoring coverage for the demolition of the 107-F Basins. A survey prior to the start of demolition determined that contamination on the basin walls was well fixed and easily controlled during demolition. Portions of the walls above the earth fill had been sprayed with asphalt to hold loose residual radionuclides. The concrete surfaces were thoroughly wet during demolition to prevent airborne particulate dispersion.

When leaving the basin area, all personnel and vehicles were surveyed by the radiation monitor technician. No personnel or vehicle contamination was found. The 107-F basin level of contamination, prior to starting Phase I demolition, determined by direct survey was 200 cpm to 3,000 cpm on the exposed portion of the concrete surfaces. Low level contamination was found on the equipment (ball, shovel) during the operation. Contamination was removed by washing with water or by using a wire brush.

A small portion of the existing fill in the 107-F Basin was excavated using a backhoe to obtain samples of sludge material next to the concrete floor. There were samples taken from three different locations within the basin and two outside of the basin. The results of the sample analysis will be available in the final report. The samples are archived in the Pacific Northwest Laboratory (PNL) for the Hanford Inactive Waste Site Surveillance Project (IWSS). The radiation survey reports and sludge sample analysis will be used along with the data in UNI-946, Radiological Characterization of the Retired 100 Areas (Ref. 7) as the basis for the final dose calculations to define the Phase II work scope.

The level of contamination, during Phase I demolition, determined by portable instrument survey was as follows:

Contamination Levels (No alpha contamination was detected.)

Dirt fill in the basin	200 to 2,000 cpm (beta-gamma)
Basin walls	200 to 1,500 cpm (beta-gamma)
Basin floor	3,000 cpm (beta-gamma)

Dose Rate Levels

Steel effluent pipes	10 mr/hr

4.2.3 Description of Instrumentation

Direct Survey Instruments

Portable survey instruments were maintained and calibrated by the Instrument Calibration and Evaluation Section, Pacific Northwest Laboratories, located in the Hanford 300 Area.

Portable beta-gamma detector:	Eberline Instrument Corporation Model BNW-1 with P-11 "Pancake Probe"
Portable alpha detector:	Eberline Instrument Corporation Model E-140B with alpha scintillation detector

5.0 DECOMMISSIONING WORK SEQUENCE

5.1 Site Preparation

The following site preparations were completed before any decommissioning work began on the 107-H Basin. All preparations complied with the approved Radiation Work Procedure (RWP) and the Decommissioning Work Procedure (DWP), which are part of the Decommissioning Project Readiness Review (DPRR) (Reference 6).

- Decommissioning Engineering and Decommissioning Operations inspection determined there were no energized power sources or active underground utilities in the area. They also provided an excavation permit.

- The chain link fence had a section removed for passage of large equipment. A controlled radiation survey checkpoint/access was established and posted.

- An initial basin survey was performed by Radiation and Water Quality Control. Health Physics obtained samples from three locations next to the bottom of the basin and two locations adjoining the outside walls per Pacific Northwest Laboratory (PNL) sample plan.

5.2 Project Activities

Work began the third week of June 1987 after the DPRR had been reviewed and approved.

An access control point was established and posted. All equipment, vehicles and personnel entered and exited through this radiation survey check point. Radiological surveys were performed by Radiation and Water Quality Control (R&WQC) including the initial basin survey, ongoing radiological work surveys and twice-a-day surveys of operating equipment.

The work area was contained by leaving the fence in place, posting warning signs, wetting walls and fill materials, and controlling access to the area being worked. No special protective clothing or equipment was required.

The dirt fill placed against the interior wall was removed. The wrecking ball then opened a row of penetrations exposing the reinforcing steel at the designated demolition baseline of the concrete wall (approximately 7 ft above the basin floor). The work surfaces received a spray of water during the operation to minimize airborne particulate. Once a section (between vertical expansion joints) of concrete wall had broken section joints and baseline, the wrecking ball would then impact the opposite side at the top forcing the wall to fall into the basin. The exterior wall baseline was where the 8 in. thick sloping bottom wall joins a 1 ft-6 in. thick upper wall. The operator's technique allowed this work to progress rapidly. The demolished walls and diversion boxes were disposed of in situ and stabilized with a 1 ft minimum layer of backfill.

The west bay demolition and stabilization was accomplished first and allowed the transfer of the stored effluent pipe (approximately fifty 30 ft sections) directly from the east bay prior to work there (July 23, 1987). Nine Hanford Plant Standards, HPS-5-40, radiation zone markers inside the basin fence which were old redundant markers not removed by Project H-538 were removed and not replaced.

Prior to backfilling over the demolished in situ rubble and components, the heavy equipment positioned material to reduce voids against future subsidence. The material was also compacted to increase the distance below grade to assure room for a bio-barrier (clean backfill). Heavy equipment driven over the backfill satisfactorily compacted the backfill to minimize post-demolition subsidence (Figures 7 & 8).

No radioactive waste was shipped to burial and no asbestos, mercury, or any other nonradioactive hazardous materials were found within the structure.

Phase I was completed during this project. The sludge analyses for in situ disposal of the basins is in process. The results of this determination will define the scope of work for Phase II.

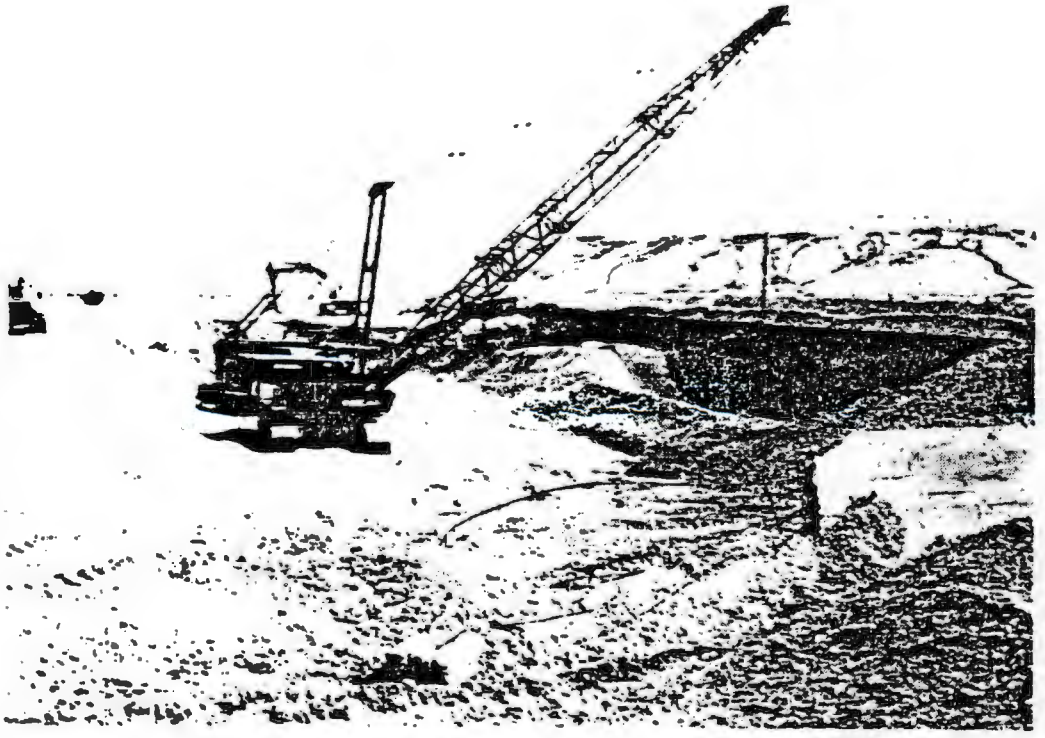

Figure 7. Demolition of Center Wall From West Bay (North View)

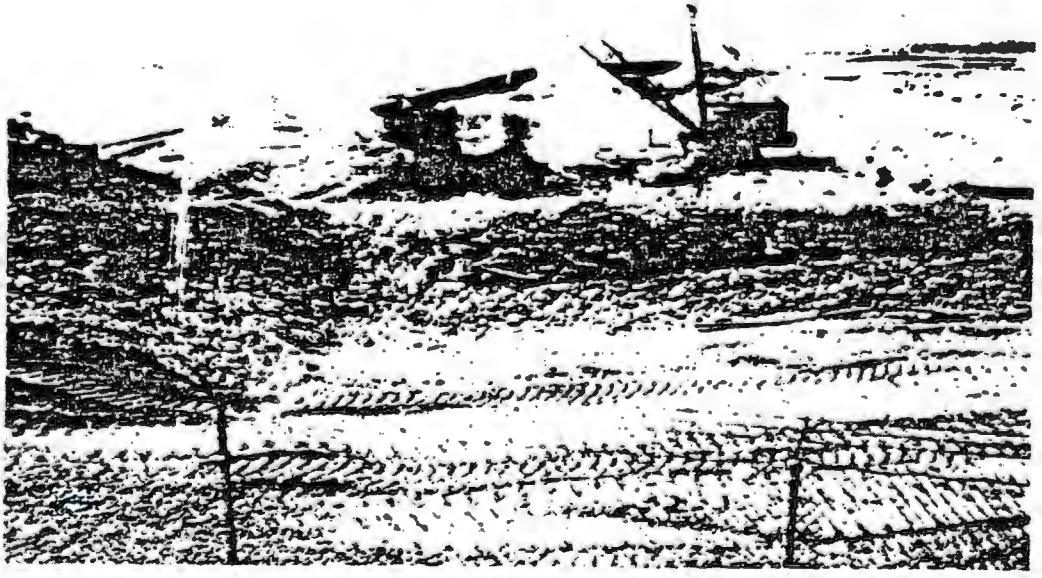

Figure 8. Demolition of East Wall From East Bay (South View)

6.0 PROJECT BUDGET AND SCHEDULE

6.1 Project Costs

The estimated cost and budgeted amount for Phase I decommissioning activities was $135,800 (including the respective proration of Advance Engineering, Advance Characterization, and Program Support. Actual costs were $128,000, including an estimated $1,100 for the completion of this Phase I report. The underrun of $7,800 represents a favorable variance of 5.7%, which is due to not requiring as much manpower as was originally estimated. The project was completed with no cost impacts as the result of the schedule delays, noted in the project schedule narrative. Table 3 summarizes the costs.

6.2 Project Schedule

Decontamination and Decommissioning (D&D) activities were initiated following the completion of the Decommissioning Project Readiness Review (DPRR) meeting on June 12, 1987. Preparatory work began on June 17, 1987 with 100 Area Operations providing backhoe support to the sampling effort of Health Physics and Pacific Northwest Laboratories. In addition, a section of the perimeter fence was removed to allow access to the interior basin.

Schedule impacts were realized due to shortages in operator support and severe windy conditions, which delayed progress in the demolition of the basin walls. Demolition of the walls was initiated on June 25, 1987. The completed demolition dates for each wall were as follows: The south wall - July 8, 1987; the west wall - July 9, 1987; the north wall - July 14, 1987; the center wall - July 21, 1987; and the east wall - August 4, 1987. The hauling of fill dirt and backfill operations commenced following completion of the east wall, but due to a breakdown in the radiation monitor equipment, these activities were stopped on August 12-18, 1987. Operations continued backfill and site grading activities on August 19, 1987 and were completed the following day. All Operations' activities were finalized on August 31, 1987 following the re-installation of the removed section of perimeter fence.

7.0 CONCLUSIONS AND LESSONS LEARNED

The 107-F Retention Basin decommissioning is part of the long-range strategy for the disposition of the Hanford Site shut-down production reactor sites. Demolition of the basin walls and component structures and covering with one foot of clean fill stabilizes the radioactive materials. Phase II will complete the protective barrier and provide site restoration.

The 107-F Basin was the fifth of 100 Area basins to use the two-phase decommissioning project plan. The Phase I work went extremely well, as did the previous basin demolition. The 107-D, -DR, -B, -C Phase I projects were completed during FY 1985 and -H was completed during FY 1986. Experience from the previously demolished basins provided an expedient and safe operation on this project and helped prevent excessive costs.

TABLE 3

HANFORD DECOMMISSIONING
107-F RETENTION BASIN DEMOLITION - PHASE I
PROJECT COSTS

($ IN 000's)

	Total
Project Management	$ 4.1
Engineering 1)	16.5
Characterization 2)	17.4
Decontamination	----
Demolition	31.2
Direct Material	1.5
Waste Disposal	----
Program Support	36.9
G&A and Department OHs	20.4
TOTAL	$128.0

1) Includes proration of Advance Engineering activities for FY 1987.

2) Includes proration of Advance Characterization activities for FY 1987.

This project utilized demolition practices learned on the four preceding basin demolition projects. An efficient wrecking ball technique, a particular crane setup, and sprayed water worked well.

The wrecking ball was used to open a row of penetrations exposing the reinforcing steel along a baseline. Then the ball was extended over the wall to impact the opposite side of the concrete wall at the top and with assistance from the D-8 dozer forcing the wall to fall into the basin. The D-8 dozer with the ripper worked the walls into the final position.

The crawler-type Linkbelt crane (Model 318, 80-ton) with 70 ft of boom and a 10,000-lb ball proved adequate for demolition where the reinforced concrete walls were about 1 ft-6 in. thick.

Spraying the work area with water proved an excellent way to minimize dust/airborne contamination during demolition work.

All decommissioning activities were performed with the utmost regard to the personnel involved. No personal injuries, radiological internal contamination or skin contamination cases occurred during this project. The occupational radiation exposure to personnel during this phase of decommissioning was essentially zero.

The 107-F Retention Basin is now ready for Phase II engineering.

8.0 REFERENCES

1. Decommissioning Services Management Guide, UNI-3073, UNC Nuclear Industries, Richland, WA, dated September 30, 1985.

2. Cost/Schedule Control System Manual for Projects and Programs, UNI-M-109 REV1, dated February 1, 1982.

3. Management Control System, RHO-GM-MA-2, dated August 8, 1986.

4. WE Kennedy, Jr. and BA Napier, Allowable Residual Contamination Levels for Decommissioning Facilities in the 100 Areas of the Hanford Site, PNL-4722/UNI-2522, Pacific Northwest Laboratory, Richland, WA, dated 1983.

5. Napier, BA, GF Piepel, and WE Kennedy, Jr., A Manual for Applying the Allowable Residual Contamination Level Method for Decommissioning Facilities in the 100 Areas of the Hanford Site, PNL-6348 dated September 1987.

6. Project Readiness Report for Decommissioning the 107-F Retention Basin, Rockwell International, Richland, WA. dated June 12, 1987.

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