CASE STUDY 5:

L-REACTOR THERMAL EFFLUENT

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Discussion Questions

The following are sample group discussion questions to consider when reading this case study:

- What was the thermal effluent discharge approach proposed by the SRS for the L-Reactor for restart?
- Why did the SCDHEC's reject this proposal?
- What is the difference between the EPA's and the State's determination of the point of compliance for thermal limits for discharges?
- What happened when the SRS submitted its NPDES renewal application in June 1981?
- What options did SRS identify to achieve compliance with the NPDES permit? Which did they select?
- What was the impact of the restart of the L-Reactor on aquatic life?
- What are possible solutions to mitigate thermal effluent discharges?

Savannah River Site History

The Savannah River Site (SRS) is located on approximately 325 square miles of land along the Savannah River south of Aiken, South Carolina. The SRS historical mission of producing nuclear materials encompassed many production, research and development, and waste management activities. The SRS houses production facilities that include a fuel and target fabrication facility, five production reactors, two chemical separations areas, a tritium processing facility, a heavy water rework plant, a uranium fuel processing facility, and the Savannah River Technology Center (formerly Savannah River Laboratory).

L-Reactor

The SRS L-Reactor is a production reactor designed to produce plutonium and tritium by the absorption of neutrons in uranium and lithium.

The reactor uses heavy water (D_2O) as a moderator and as the primary coolant to remove heat generated by the nuclear fission process. Water from the Savannah River is used for secondary cooling purposes and is discharged back to the Savannah River via Steel Creek. The reactor began operation in 1954 and was placed in official standby status in 1968 (due to a decreased demand for nuclear defense materials). The reactor site consists of approximately 82 acres and is located in the south-central portion of the SRS. The facility is located about six miles from the nearest SRS boundary.

In March 1981, the DOE initiated activities to renovate and upgrade the L-Reactor for restart. The project's goal was to achieve the same level of condition as that of the other SRS operating reactors. Resumption of reactor operations was expected to affect the same areas as facility operations had previously. The DOE decided to utilize water from the Savannah River for secondary cooling and to discharge the thermal effluent, without cooling, back to the same river via Steel Creek. Previous reactor operation had proven that discharge temperature in the reactor effluent canal and the immediate vicinity of Steel Creek could reach 170°F. Based on this information, the South Carolina Department of Health and Environmental Control (SCDHEC) did not approve of this discharge approach and forced the DOE to implement thermal mitigation for the L-Reactor. The L-Reactor operation began again in late 1985.

Thermal Effluent and NPDES Permitting

The first SRS National Pollutant Discharge Elimination System (NPDES) permit, issued by the EPA in 1976, contained a thermal variance for on-site streams (i.e., thermal limits were set in the Savannah River). Site streams receiving reactor effluent did not have to meet thermal standards until they reached the Savannah River. Based on the permit, a direct discharge to Steel Creek was, at that time, judged to be legal. The discharge did not meet the State's water quality thermal standards issued in the late seventies.

NPDES authority for Federal facilities was transferred to the State in 1980. Subsequently, the SRS submitted its NPDES renewal application in June 1981 and was, in turn, issued a draft permit containing thermal limits at the Savannah River. However, this draft permit did not disclose any thermal variance criteria. The SRS requested that the variance be inserted into the permit. The State's response was that, to their understanding, a variance in the permit was not necessary as the SRS had been issued a formal variance through the existing regulatory process. The SRS responded that the issuance of a formal variance had never happened -- that the EPA had simply written one into the permit. The State then issued the SRS an NPDES permit requiring thermal compliance at the point of discharge. The SRS found the reactor thermal standards in the permit impossible to meet through use of its current direct discharge procedures. In order to attain compliance with the permit, the SRS had the following choices:

- Construct off-stream cooling facilities to meet thermal limits.
- Obtain a thermal variance based on the Clean Water Act (CWA) Section 316(a) study showing that a balanced biological community exists in the thermal areas.
- Submit a request to the SCDHEC to reclassify the South Carolina quality classification of the on-site thermally impacted streams.

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As a result of not having a regulatory variance and due to unacceptable thermal levels, the State also found the SRS in violation of water quality standards that had been approved by the EPA under the CWA. No fines were imposed; however, the SRS agreed to enter into a consent order to undertake thermal mitigation studies for the on-site streams.

Thermal Mitigation

As a result of the State prohibiting direct discharge of reactor effluent into on-site streams, the SRS explored other thermal mitigative options for the restart of the L-Reactor. A formal request to reclassify Steel Creek as a receptor of industrial cooling water was submitted to the SCDHEC but was not approved. Once-through and recirculating cooling options were then evaluated (with respect to schedule, cost, and wetland impacts). The schedule and costs for design, permitting, and construction for recirculating systems (e.g., a cooling tower) were excessive compared to once-through systems. The DOE determined that the markedly higher costs and schedule details for all recirculating options and most once-through options did not justify their selection. The DOE's final decision was to construct a 1,000-acre cooling lake (L-Lake). This type of thermal mitigation was the most reasonable option based on schedule, cost, and impact to wetlands.

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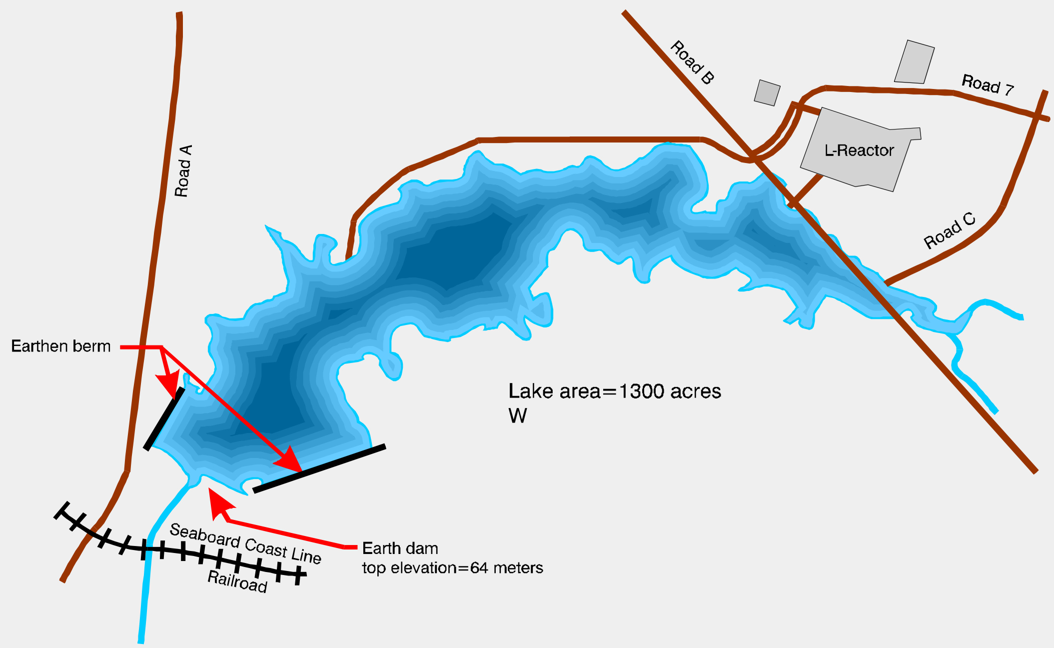

L-Lake

The lake was constructed by erecting an earthen dam across Steel Creek. The SRS assumed that almost all of the lake's 1,000 acres would be available for cooling purposes. Due to schedule pressure, the lake construction project was begun before the L-Reactor NPDES permit was finalized. As a result, the SRS did not know what final permit limitations and restrictions would be imposed. Consequently, problems arose once the permit was finalized. The SCDHEC stipulated that a CWA Section 316(a) biological study be performed (as the point of discharge could not meet thermal water quality standards) and that the southern half of the lake's surface needed to be kept at 90°F or less. Thus, the total number of acres that the SRS had planned on for cooling was reduced by approximately 50 percent. This permit-oriented stipulation lent another twist to the SRS' thermal mitigation plans. During South Carolina's hot summer months, the surface temperature of the lake would approach the 90°F limit. It was found that for the L-Reactor to run year-round, the SRS would need either (1) a larger lake, or (2) additional cooling measures.

L-Lake's Aquatic Life

The restart of the L-Reactor had an impact on the lake's aquatic life. During periods when the reactor was down, fish (from the lake's south end) would enter the north end and reside close to the reactor discharge area. When the reactor came up, and thermal effluent was again discharged from the facility, fish residing in the north end would become trapped in either the effluent canal pockets or in small bays. These trapped fish would eventually die from the heat. Consequently, fish kills (totalling over 3.8 million) were reported in 1986, 1987, and 1988. These kills consisted primarily of fingerling-size fish. The Section 316(a) study indicated that these fish kills had no adverse impact on the growth of the balanced biological community in the lake. Therefore, the DOE stated that the fish kills should be considered acceptable. The State rejected the Section 316(a) study argument as irrelevant (as State laws require that adverse impacts to aquatic life are not allowed) and issued a Notice of Violation (NOV) against the SRS. The State and SRS entered into a settlement agreement that mandated a fish-kill mitigation effort. A fish kill mitigation plan was submitted to and approved by the State. The L-Reactor could still operate as long as these mitigative efforts were underway.

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L-Reactor Shut Down

The L-Reactor was shut down in 1988 due to unresolved safety issues. At that point in time, the SRS was still actively pursuing mitigative efforts to alleviate/eliminate fish kills.