



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
CONCERNING A POSTULATED BREAKOUT OF SPIRIT LAKE
AND ITS IMPACTS ON THE TROJAN PLANT
DOCKET NO. 50-344

1. Purpose of Report

On May 18, 1980, Mount St. Helens erupted and caused a massive mudflow flood that deposited a large amount of sediment and debris in the Columbia River near the mouth of the Cowlitz River. The Trojan Nuclear Plant which is located on the west bank of the Columbia River about 4.5 miles upstream of the mouth of the Cowlitz River (See Figure 1) was not directly affected by the sediment deposited in the Columbia River, although large deposits were measured near the intake structure. In addition to the mudflow flood, the eruption also resulted in an avalanche of rock, mud and ice that swept down the slopes of Mount St. Helens into Spirit Lake and the Upper Toutle River Valley. As the debris avalanche slid into Spirit Lake, it displaced the lake level upward by more than 200 feet. The avalanche also deposited an estimated 3.9 billion cubic yards (bcy) of sediment in the upper 17 miles of the North Fork Toutle River Valley and blocked the outlet channel of Spirit Lake with debris ranging in depth to 500 feet. This debris-blockage, which is a massive and unstable deposit, caused a dramatic increase in the volume of water stored in Spirit Lake. Because of the unstable nature of the debris blockage, there was a concern that Spirit Lake could breach the blockage and cause a mudflow flood that could possibly affect the safe operation of the Trojan Plant. This report addresses the potential effects of such a mudflow flood at the Trojan Plant.

2. Introduction

Mudflows associated with the May 1980 eruption moved down the Toutle River and carried more than 50 million cubic yards (mcy) of material into the Cowlitz River and its overbank areas. An additional 45 mcy were deposited in the Columbia River, mostly in a 9-mile reach of the river extending from about 5 miles downstream of the mouth of the Cowlitz River to 4 miles upstream.

In the fall of 1981, a task force organized by the U.S. National Forest Service determined that the effective crest of the debris blocking the Spirit Lake outlet would deteriorate from elevation of 3490 ft to 3475 ft during the winter of 1982-83 because of subsidence and erosion. It was estimated that Spirit Lake would fill to elevation 3475 ft (314,000 acre-feet) sometime in March 1983 assuming that no action was taken to reduce the level and volume of the lake and that the annual inflow was average. Were this to happen, there would be a very high potential for failure of the blockage and catastrophic flooding downstream. To reduce the potential for failure, the Corps of Engineers, as an interim measure, constructed a pumping facility at Spirit Lake and pumping began on November 5, 1982 (see Figure 2). The goal of the pumping operation was to

stabilize the lake level at an elevation of about 3,462 ft, which corresponds to a lake volume of about 275,000 acre-feet. However, greater-than-normal rainfall, failure or disruption of the pumping system and/or addition of debris into Spirit Lake from a subsequent eruption could cause the lake level to rise excessively. In an extreme case the debris blockage could fail. Because of the potential public safety hazard associated with a breakout of Spirit Lake, the Corps of Engineers drilled a tunnel from Spirit Lake to South Coldwater Creek (See Figure 2). This tunnel allows Spirit Lake to drain so that the lake level can be maintained at an elevation low enough to remove the threat of a Spirit Lake debris dam failure and consequent mudflow flood. Construction of the tunnel was initiated in July 1984 and completed in April 1985. It is expected that Spirit Lake will be drawn down to a level where the debris dam is stable by September 1985.

3. Analysis

In a report titled "Analysis of Flood Level at Trojan Plant Associated with Hypothetical Failure of Spirit Lake Blockage," by Simons, Li and Associates, Inc.; the licensee addressed the potential impact of a Spirit Lake breakout on the Trojan Plant. The depth of flooding in the Columbia River would be dependent on the coincident discharge in the river at the time the breakout flood peak arrived at the mouth of the Cowlitz River. Thus the licensee determined water surface elevations corresponding to various coincident discharges in the Columbia River. Results of their study were as follows:

SIMMONS AND LI REPORT
Resultant Water Surface Elevations in
the Columbia River at the Trojan Plant
due to a postulated breakout of Spirit
Lake

Coincident Columbia River Discharge in cfs	125,000	400,000	800,000
Columbia River Water Surface Elevations in feet at the Trojan Plant	31	35	39

This table shows that a postulated breakout of Spirit Lake occurring coincident with an 800,000 cfs flood flow in the Columbia River would not affect the safe operation of the Trojan Plant because the plant grade elevation, at 45 feet, is 6 feet higher than the flood level would be.

A potential breakout of Spirit Lake was also of concern to the U.S. Federal Emergency Management Agency (FEMA) because flooding from a breakout could have a severe impact on public safety and on the regional economy. To enable it to plan for such an event, FEMA requested the USGS to study the impacts of a

Spirit Lake breakout on the entire lower Columbia River. The USGS study report titled, "Impact on the Columbia River of an Outburst of Spirit Lake," addresses the impacts of a postulated breakout of Spirit Lake on the Columbia River from Bonneville Dam to the mouth. The Trojan Plant is located within this stretch of the river.

The USGS, using a sediment transport computer model, concluded that following a postulated breakout of Spirit Lake, a large sediment blockage would form in the Columbia River at the confluence of the Cowlitz, with subsequent impoundment of water upstream of the blockage. This blockage would result in a slowly rising water level at the Trojan Plant which would continue for 16 days after the blockage formed.

As stated above, the depth of flooding in the Columbia River would be dependent on the coincident discharge in the river at the time the breakout flood peak arrived at the mouth of the Cowlitz River. The USGS also determined surface water elevations corresponding to various coincident discharges in the Columbia River. Results of their study were as follows:

USGS REPORT Resultant Water Surface Elevations in the Columbia River at the Trojan Plant due to a postulated breakout of Spirit Lake					
Coincident Columbia River Discharge in cfs	233,000	410,000	610,000	750,000	820,000
Recurrence Interval in years	(average)	(2year)	(10year)	(50year)	(100year)
Columbia River Water Surface Elevation in feet at the Trojan Plant	32	38	41	43	44

The results of the USGS study are similar to the licensee's study in that a postulated breakout of Spirit Lake occurring coincident with a flood in the Columbia River as severe as a 100 year event would not affect the safe operation of the Trojan Plant because the plant grade elevation is higher at 45 ft than the flood level would be.

4. Summary and Conclusion

By pumping water out of Spirit Lake as an interim measure, the Corps of Engineers was successful in maintaining the Lake level at an elevation that minimized the chances for a breakout and the potential threat to the Trojan

Plant. However, prior to completion of the permanent drainage tunnel, the staff remained concerned because it was uncertain about whether or not a lake breakout and the ensuing flood could affect the safe operation of the plant. The licensee and the USGS studies, however, provided information that indicated that even if Spirit Lake did break out, the resultant flood level in the Columbia River at the Trojan Plant would not rise as high as plant grade even if the breakout occurred coincident with a 100 year flood discharge in the Columbia River.

The tunnel between Spirit Lake and South Coldwater Creek (See Figure 2) provides a permanent outlet for Spirit Lake. This tunnel will maintain the level of Spirit Lake at an elevation that will reduce the threat of a breakout and the potential for high water in the Columbia River at the Trojan Plant.

The staff concludes that a breakout of Spirit Lake would not affect the safe operation of the Trojan Plant. Furthermore, once Spirit Lake is lowered to a safe level, there will be no safety concern regarding a breakout as far as the Trojan Plant is concerned.

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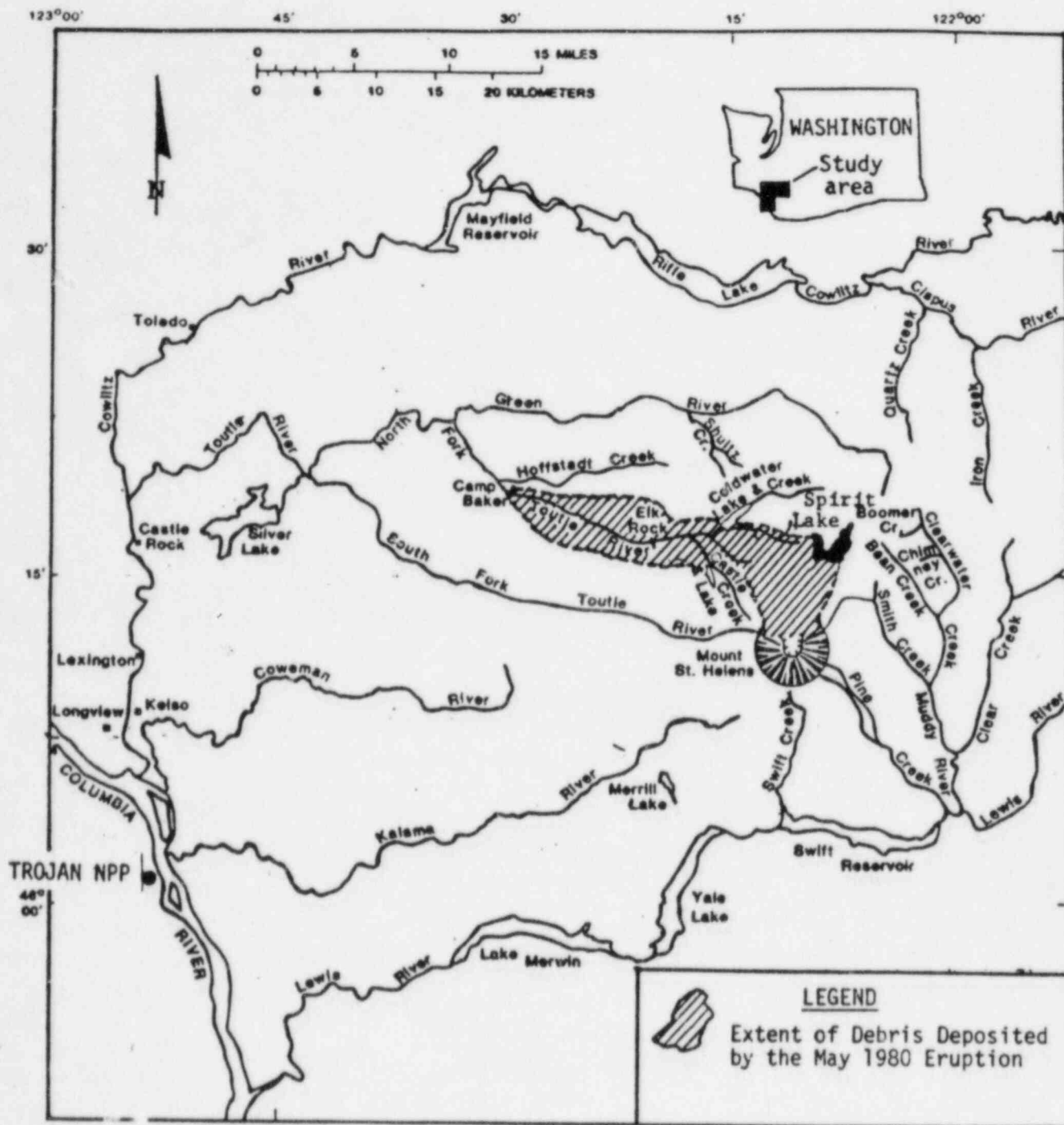


FIGURE 1
GENERAL AREA MAP - TROJAN/SPIRIT LAKE/MOUNT ST. HELENS

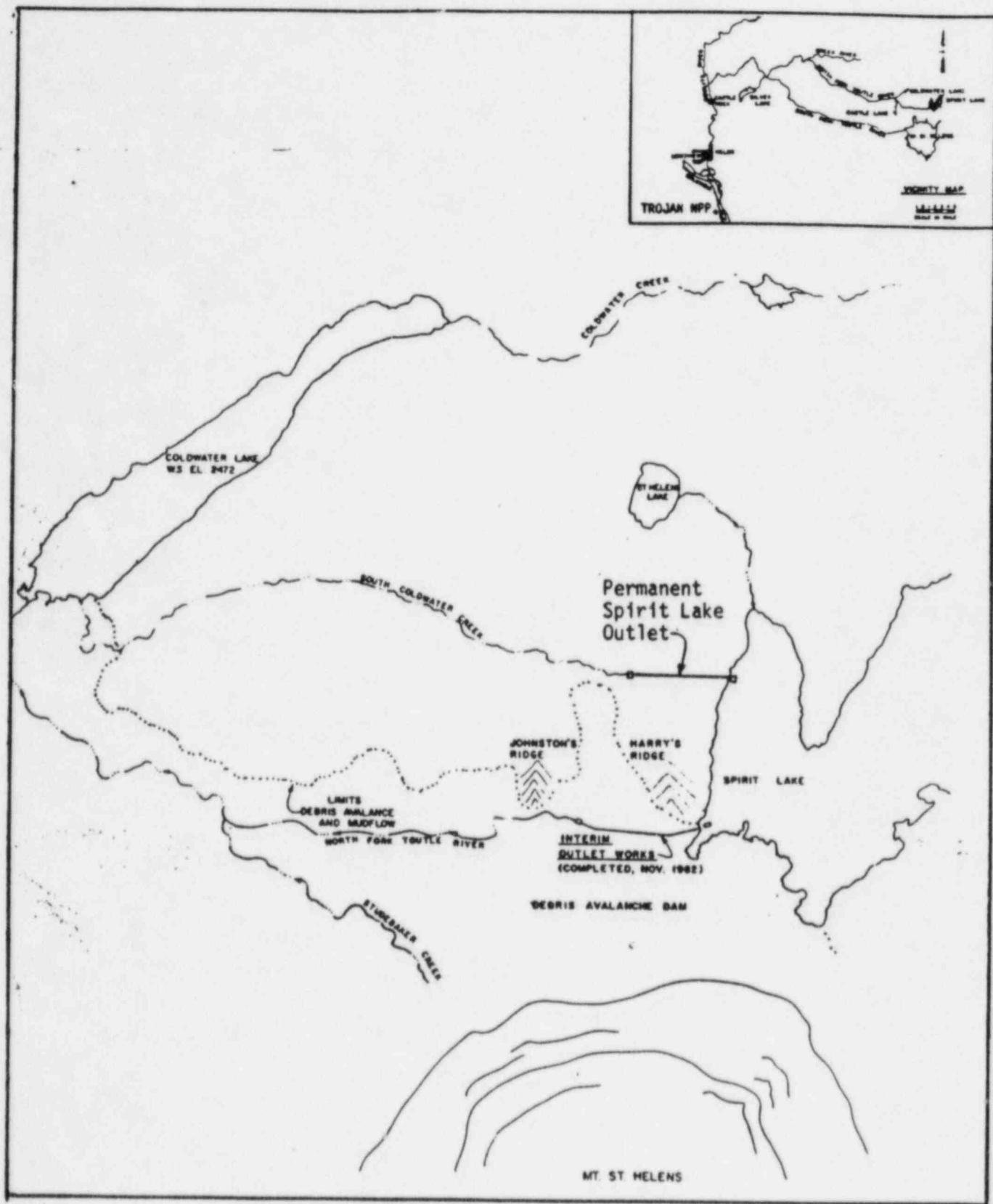


FIGURE 2
LOCATION OF SPIRIT LAKE OUTLET

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