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Project No. 222C-EIS

Mr. Ronald E. Young, PE, DEE
General Manager
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31315 Chaney Street
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Subject: Supplement No. 1 to Geotechnical Feasibility Report
Preliminary Guidelines for a Monitoring and Surveillance Program
Lake Elsinore Advanced Pumped Storage Project (LEAPS)
Riverside County, California

Dear Mr. Young:

INTRODUCTION

At the request of The Nevada Hydro Company, Inc., GENTERRA Consultants, Inc. is pleased to submit this letter presenting GENTERRA's preliminary guidelines for a monitoring and surveillance program for the project facilities of the Lake Elsinore Advanced Pumped Storage Project (LEAPS) in Riverside County, California. This letter is considered a supplemental document to the Geotechnical Feasibility Report (GENTERRA, 2003) previously submitted to the District.

For the LEAPS project facilities, a monitoring and surveillance program shall be developed during the design phase of the project. At this time, the project is currently in the conceptual design phase and the exact locations and configurations of the project facilities have not been determined. The proposed project facilities include the following:

- An upper reservoir that includes a major (over 200-foot high) dam, dikes, spillway, low-level outlet, and an intake structure.
- A penstock consisting of shafts and tunnels (concrete and steel lined).
- A powerhouse that contains the hydraulic machinery.
- A tailrace tunnel (concrete lined).

PURPOSE AND DESCRIPTION

The purpose of the monitoring and surveillance program is stated in subsection 12.32 of Title 18, Chapter 1, Part of the Code of Federal Regulations (18 CFR):

"the project works of each development...must be periodically inspected and evaluated...to identify any actual or potential deficiencies, whether in the condition of those project works or in the quality or adequacy of project maintenance, surveillance, or methods of operation, that might endanger public safety."

While all of the project features are to be inspected and evaluated on a regular basis, the major focus of the monitoring and surveillance program is the safety of the upper reservoir dam and appurtenant structures (spillway, etc.). A monitoring and surveillance program is considered an integral part of proper stewardship for a dam. The American Society of Civil Engineers (ASCE) Task Committee on Instrumentation and Monitoring Dam Performance (ASCE 2000) states:

“Along with design and construction, monitoring dam performance is critical to producing and maintaining a safe dam. Instrumentation and measurement systems on dams are necessary to provide data for evaluating the dam’s performance compared to design and expectations, provide an early warning of changes that could affect the integrity of the dam, to increase knowledge of dam behavior, and to assist in investigations and diagnosis of abnormal dam performance.”

In general, the monitoring and surveillance program for the upper reservoir dam should include the following elements:

- Specific objectives.
- Description of the surveillance instrumentation and its precise location.
- A data collection program that includes responsibilities and schedules for the personnel involved.
- Data analysis procedures.
- Procedures for identifying and responding to critical changes.
- Procedures for effective maintenance of the instrumentation.
- Procedures for training the personnel who carry out the plan.

All of the project facilities will be under the jurisdiction of the Federal Energy Regulatory Commission (FERC), since the LEAPS project will be a licensed hydroelectric project development (18 CFR, Subsection 12.30). The upper reservoir and dam will also be under the jurisdiction of the State of California, Department of Water Resources, Division of Safety of Dams (DSOD), because of the size of the dam and reservoir (California Water Code, Sections 6002, 6003 and 6076).

FERC requires the periodic inspection and safety evaluation of the dam and project facilities (18 CFR, Subsection 12.32); currently, this is performed every five years. DSOD will also inspect the dam and reservoir on a periodic basis (Water Code, Section 6102); currently, this inspection is usually performed on an annual basis.

The following sections present preliminary recommendations for the monitoring and surveillance program for the LEAPS project facilities and general procedures for unusual or emergency situations. These discussions are based on GENTERRA’s experience with other projects and information presented in the Geotechnical Feasibility Report for LEAPS (GENTERRA, 2003).

PRELIMINARY MONITORING AND SURVEILLANCE PROGRAM

Visual Surveillance

Visual surveillance is one of the most critical components of the monitoring and surveillance program. The trained human eye is often the best instrument for assessing the performance of a facility (Dunnicliff, 1988). Visual surveillance of the LEAPS facilities will be performed by engineers, regulatory personnel, and operations and maintenance personnel.

During the daily, weekly, and monthly operations, the operations and maintenance personnel should be routinely observing the condition of the dam and appurtenant structures, intake and outlet structures, shafts, tunnels, and powerhouse looking for signs of distress, equipment malfunction, movement, seepage, or unusual conditions, and confirming that critical facilities are functional. GENTERRA recommends that the monitoring and surveillance program include training for the LEAPS Project operations and maintenance personnel to perform visual surveillance.

In addition to the five-year safety evaluation performed for FERC and the annual inspection performed by DSOD personnel, due to the large size of the dam and reservoir, GENTERRA recommends that an independent field evaluation of the dam and reservoir by qualified engineers be performed on a semi-annual basis as part of the monitoring and surveillance program.

Surveillance Instrumentation for Embankment Dams

For embankment dams, the following table presents common properties that are measured and the type of instruments used in a dam surveillance program.

Property to be Measured	Location at Facility	Typical Instruments
Alignment	Crest or other surface location of interest	Total station, GPS, laser
Internal Movement	At points of interest within foundation and embankment	Inclinometer, settlement gage, extensometer
Water pressure	Within embankment and foundation	Vibrating wire piezometer, open-well piezometer, observation well
Stress	Within embankment or foundation	Total pressure cell
Seepage Quantity	Any location of interest	Flow meter, weir, calibrated container
Seepage Quality	Any location of interest	Turbidity meter

Not all of the above properties are monitored for all embankment dams in all locations. Some properties may be of more importance than other properties depending upon the type of dam.

The monitoring and surveillance program will address the properties to be measured, the types of instrumentation needed to measure the property, the precise locations for installation, and the operations and maintenance of the instrumentation.

Surveillance Instrumentation for the Upper Reservoir

The following table presents general properties that are measured in the area of a reservoir in a monitoring and surveillance program.

Property to be Measured	Location at Facility	Typical Instruments
Precipitation	Facility Area	Rain gage
Flow	Inlet, Outlet	Flow meter, Stage recorder
Reservoir Water Level	Reservoir	Pressure Transducer, staff gage
Air Temperature	Facility Area	Thermometer
Water Temperature	Seepage	Thermometer, Thermistor
Wind	Facility Area	Anemometer
Atmospheric Pressure	Facility Area	Barometer
Water Quality	Reservoir, Groundwater, Seepage	Physical and chemical analysis
Reservoir Rim	Point of Interest	Inclinometer, piezometer, survey monument, extensometer
Seismicity	Dam and free field	Strong motion accelerometer

The above properties are general and for informational purposes. Not all of the data may need to be monitored at the LEAPS upper reservoir. For example, the El Cariso Guard Station (operated by the U.S. Forest Service) located approximately one mile from the proposed upper reservoir location has a weather gage that may supply a number of the above properties on an as-needed basis.

Surveillance of Penstocks, Powerhouse and Tailrace

The monitoring and surveillance program for the penstock shafts and tunnels, and the tailrace tunnel will consist of inspecting the conduits when the facility can be shut down and the conduits can be dewatered. Areas of distress or necessary repair can then be observed and acted upon. FERC (18 CFR, Subsections 12.10 and 12.11) and DSOD (Water Code, Section 6101) will be notified of the incidents and necessary actions.

The powerhouse will be observed daily during normal operations by the onsite personnel. Any incidents that may affect the safety of the project would be reported to FERC (18 CFR, Subsections 12.10 and 12.11) and DSOD (Water Code, Section 6101).

In general, no surveillance instrumentation will be necessary for the shafts, tunnels, and powerhouse. If areas of distress develop, appropriate instrumentation (such as strain gauges, extensometers, etc.) can be installed to monitor future movement and included in the surveillance program.

Frequency of Instrumentation Measurements

The frequency of field surveillance and data collection is based on the type of data being collected, the expected rate of change of the parameter, and the method of data acquisition. For example, a high frequency of readings will be required during construction, immediately after construction, during initial filling, during the first drawdown, and during unusual occurrences. A low frequency of readings can be used after a long-term trend of historical information has been established. Some of the monitoring instrumentation can be abandoned after the initial filling of the upper reservoir and long-term trends have been established. Key instrumentation will continue to be read for the life of the structures. The monitoring and surveillance program should address the frequency of readings and the criteria to be used to adjust the frequency as well as the criteria for abandonment of instrumentation.

PROCEDURES FOR UNUSUAL OCCURRENCES AND EMERGENCIES

The monitoring and surveillance program will address the procedures for unusual occurrences and emergencies. The following are some general guidelines for the development of the procedures.

Procedures for Unusual Occurrences - An unusual occurrence is an event that takes place or a condition that develops that is not normally encountered in the routine operation of the dam and reservoir, which may endanger the dam or necessitates either a temporary or permanent revision of the operating procedures. Unusual occurrences may include severe earthquake shaking at the dam and reservoir, increased seepage, abnormal instrumentation readings, landslides, refilling the reservoir, and severe storms. The general procedure is to increase the frequency of visual surveillance and monitoring data collection. Special evaluation of the data may be warranted.

Procedures for Emergency Conditions - An emergency condition is a condition of a serious nature that develops suddenly and unexpectedly, that will endanger the structural integrity of the dam or endanger downstream persons and property, and that requires immediate attention. This condition usually occurs in the event of the impending or sudden uncontrolled release of water caused by failure of the dam or its appurtenant facilities (inlet/outlet works, spillway, etc.). If failure of the dam is imminent or has occurred, as verified by an observer, personnel shall begin Emergency Action Plan notification and arrange to maximize flows from the outlet valves, if practical.

Any incidents that may affect the safety of the project would be reported to FERC (18 CFR, Subsections 12.10 and 12.11) and DSOD (Water Code, Section 6101).

Please feel free to contact either of the undersigned at (949) 753-8766 at any time to discuss this supplemental information, answer any questions, or provide additional information.

Sincerely,
GENTERRA CONSULTANTS, INC.



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REFERENCES

American Society of Civil Engineers (2000), "Guidelines for Instrumentation and Measurements for Monitoring Dam Performance", ASCE Task Committee on Instrumentation and Monitoring Dam Performance, ASCE, Reston, Virginia

Dunnicliff, L. (1988) "Geotechnical Instrumentation for Monitoring Field Performance", John Wiley and Sons.

GENTERRA (2003), "Geotechnical Feasibility Report, Lake Elsinore Advanced Pumped Storage Project (LEAPS), FERC Project No. 11858, Riverside County, California", GENTERRA Consultants, Inc., Irvine, California, August 6, 2003