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OAK RIDGE NATIONAL LABORATORY

LOCKHEED MARTIN

MANAGEMENT PLAN FOR WHITE OAK DAM

Revision 1

Original Prepared by: Teresa J. Pierce

Revision 1 Prepared by: Syed B. Ahmed

for

LOCKHEED MARTIN ENERGY RESEARCH, INC.
Post Office Box 2008
Oak Ridge, Tennessee 37831

March 1997

MANAGED AND OPERATED BY
LOCKHEED MARTIN ENERGY RESEARCH CORPORATION
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

ORNL-27 (3-96)

DISCLAIMER

Revision Date: March 1997 Document Number: X-OE-438*(R1)*

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Lockheed Martin Energy Research, Inc.
Post Office Box 2008
Oak Ridge, Tennessee 37831

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Approved by: ***J. S. Abercrombie***, Laboratory Shift ***Superintendent's*** Coordinator

W J DeRossett Date: 3/7/97
Approved by: ***W. J. DeRossett***, Emergency Preparedness ***Department Head***

Date: 3-7-97
Approved by: E. H. Krieg, Jr., Director, ***ORNL Engineering & Construction Management***

Date: 3/10/97
Approved by: ***J. H. Swanks, Associate Laboratory Director, Operations, Environment, Safety, and Health***

Table of Contents

MANAGEMENT PLAN FOR WHITE OAK DAM

I. PURPOSE

To provide operation and maintenance, periodic inspection, and emergency action plans for White Oak Dam in general accordance with the Federal Emergency Management Agency (FEMA) guidelines for dam safety.

II. REFERENCES

A. Federal Emergency Management Agency (June, 1979), "Federal Guidelines for Dam Safety," Federal Coordinating Council for Science, Engineering and Technology, Washington D.C.

B. "Emergency Events at White Oak Dam" EM-E2, 11-94.

C. "X-10 Site Emergency Plan" (ORNL/CF-91/71/R2), September 30, 1994.

D. "Notification of Operational Emergencies to Off-Site Officials" LS-35, 8-95.

E. U. S. Army Corps of Engineers, "Recommended Guidelines for Safety Inspection of Dams," 1973.

III. REQUIREMENTS

A. General Requirements

1. Operation and Maintenance - A plan shall be maintained that provides guidelines for operation and regularly scheduled maintenance of the dam and its associated structures and equipment.

2. Periodic Inspection Program - A formal inspection program shall be maintained which lists the features to be inspected, frequency of inspections, types of inspections, inspection schedule, and description of required repairs.

3. Emergency Action Planning - A plan shall be maintained to prevent failure or to minimize the effects of failure. Actions to be taken upon discovery of a potential problem shall be outlined. The plan shall be in accordance with ***Department of Energy*** (DOE) Orders and shall include notification, warning, and response actions.

B. Responsibilities

1. *Office of Environmental Compliance and Documentation (OECD)*

a) Operation and Maintenance

1) OECD provides Management of Operation and Maintenance of the gates and monitoring station including instrumentation that provides real time signals to the Waste Operations Control Center (WOCC) and Laboratory Emergency Response Center (LERC) for lake level, channel flow rate and gross Beta-Gamma count rate.

2) Personnel at the WOCC will monitor the computerized flow data. Instrument problems and failures will be routinely revealed through data review, system alarms, and normal WOCC operations. The telemetry system will be serviced under the direction of Waste Management Operations.

3) A detailed "Operation and Maintenance Plan" is given in Appendix A to the "Management Plan for White Oak Dam".

b) Emergency Action Planning

OECD personnel will provide support to the Laboratory Shift Superintendent (LSS) during high water level emergencies as outlined in Appendix C.

2. *LMER Engineering & Construction Management*

a) Records Management/Quality Assurance - ***A file will be maintained on*** White Oak Dam including historical records, inspection reports, surveying reports and copies of the "Management Plan for White Oak Dam" and "Procedure For Emergency Events at White Oak Dam". ***A "self audit" will be conducted*** to periodically verify that the "Management Plan for White Oak Dam" is being followed.

b) Periodic Inspection Program - The formal inspection program which lists the features to be inspected, frequency of inspections, types of inspections, inspection schedule, and descriptions of required repairs ***will be maintained***. Details of this program are provided in the "Periodic Inspection Program for White Oak Dam" (Appendix B to the "Management Plan for White Oak Dam").

c) Emergency Action Planning

1) A survey crew will check the coordinates and elevations of survey monuments which have been installed on the crest and downstream face of White Oak Dam. Checks will be made ***once every six months under normal operating conditions*** or more frequently if the lake elevation rises to 749 ft. or above.

2) ***Additional*** responsibilities of the ***LMER Engineering & Construction Management survey crew*** are outlined in the "Contingency Plan for Movement Detection at White Oak Dam" (Appendix D to the "Management Plan for White Oak Dam").

3. Laboratory Shift ***Superintendent*** (LSS)

a) Records Management - The LSS will maintain a file on White Oak Dam including intermediate, formal and special inspection reports, and the "Management Plan for White Oak Dam" .

b) Emergency Action Planning

1) As outlined in the "Contingency Plan for High Water Level at White Oak Dam," ***(Appendix C)*** the LSS will receive a phone call from the Waste Operations Control Center (WOCC) after a computer generated alarm has been triggered by a flow rate of 200,000 GPM at White Oak Dam. This flow rate indicates that White Oak Lake has an elevated pool level (approx. lake elevation 749 ft.). Representatives that have been dispatched to the dam by the LSS will read the actual lake level from a staff gauge located at the dam.

If the lake level increases to 752 ft., the ***Emergency Operations Cadre (EOC)*** will be assembled and will evaluate the possibility of overtopping and recommend actions to be taken if overtopping of the dam is imminent.

2) As outlined in the "Contingency Plan for Movement Detection at White Oak Dam," ***(Appendix D)*** the LSS will alert the other members of the ***EOC*** after receiving notification from ***LMER Engineering & Construction Management*** that movement of the monuments has been detected. The ***EOC*** will determine what corrective actions should be taken.

Appendix A

OPERATION AND MAINTENANCE PLAN

Information stated here is for the purpose of satisfying the requirement that a maintenance and operation plan be maintained as part of the Management Plan for White Oak Dam. It must be understood that operations at the site are primarily for purposes of environmental monitoring, environmental protection and waste management operations control. Effluent is generally allowed to flow from the lake at its natural rate by rising above the broad crested weir notch elevation of 744 feet m.s.l. The activities described herein are subparts of other more elaborate maintenance and operational systems and are listed here for reference purposes.

I. Gates, structures and mechanical equipment

Description:

The main effluent channel at the dam is approximately 40 feet wide. At the east end of the channel there is a gate structure that supports two 18 ft wide lift gates. The gate plates are 9 ft tall. The channel bottom is at approximately 741 ft elevation. In the closed position, the top of the gates can block effluent of the lake to an elevation of 750 ft and an estimated storage volume of about 10.5 million gallons. The gates are normally maintained in a raised position near the midpoint of their travel. Maximum elevation of the bottom of the gates is about 754 ft elevation. This allows the shortest travel to maximum open or closed position and avoids any significant hold up of effluent even during large storm events.

Each gate has an electrically driven mechanical gear lift device with manual backup. The systems have torque limited electric motors driving gear boxes and jack shafts that in turn drive an acme threaded lift rod at each end of the gate.

Approximately 40 ft west of the gates there is a v-shaped broad crested weir with a notch elevation of 744 ft. This primary device acts as the control of effluent.

A. Gates and mechanical equipment

Both gates will be tested once each calendar quarter for electrical and mechanical function. ***Gates are inspected once each quarter under a preventive maintenance program at the direction of OECD.***

B. Structural

Structural inspection programs are covered *in Appendix B.*

II. Instrumentation

Description

The instrumentation used for this purpose is the STD-9600 Flow Computer/Datalogger, a PC-based unit that performs a variety of functions including; "real-time" flow computation based on head input, flow totalizer, flow proportional sampler pacing, and monitors and records various parameters as determined by the software program. The hydraulic head measurements used to calculate flow rates are accomplished by three (3) Direct Digital Access magnetostrictive level gauges which are mounted in the three stilling wells and referenced to the two primary flow devices. An analog Flow signal is fed to WOCC and LERC systems via telephone lines in real-time.

Additionally, a magnetostrictive level gauge monitors White Oak Lake level and is mounted on the concrete dam structure, upstream of the gates. The height signal is fed to an Olympic Level Indicator (mounted on the west exterior wall of the building) which provides a local display and an analog signal to the STD-9600, WOCC and LERC. Its readout is in Mean Sea Level (MSL). The range of this device is 744.3 feet MSL to 760 feet MSL.

Lastly, Beta-Gamma activity in the effluent discharge is monitored at White Oak Dam using a Q-5968 Countratemeter (CRM), a 106C GM tube, mounted in a flow chamber. Lake water is pumped into the flow chamber, past the GM tube, and back into the lake. The CRM monitors for increased activity of radioactivity in the discharge water. An analog count-per-minute (CPM) signal is fed to WOCC as well as a Low Flow Alarm, indicating that the flow through the chamber has dropped below 0.5 GPM.

A. STD-9600 Flow Computer/Datalogger

1. Calibration

The STD-9600 is calibrated as a system every 6 months according to Instrument and Control (I&C) procedure MMD/GMSN1010. Completed datasheets from these calibrations are maintained by LSS and the OECD Maintenance Coordinator.

2. *Maintenance*

Periodic preventative maintenance (PM) is performed on a scheduled basis, while instrument problems and failures are routinely revealed through site inspections, data review, system alarms and WOCC operations.

B. *Countratemeter Q-5968*

1. *Calibration*

The CRM is electronically calibrated annually using I&C procedure MMD/CMNA1800. At least once per quarter, the rad monitoring system is response checked with a check source to ensure that the system is working within expected levels.

2. *Maintenance*

Periodic preventative maintenance (PM) is performed on a scheduled basis, while instrument problems and failures are routinely revealed through site inspections, system alarms and WOCC operations.

Problems are reported to the OECD Maintenance Coordinator and routed to support organizations for resolution. Off shift emergency repairs are facilitated through the LSS office. All maintenance work is tracked and recorded by the OECD Maintenance Coordinator.

C. *Data Acquisition System*

1. *WOCC/LERC*

This data acquisition system is operated and serviced under the direction of Waste Management Operations. Their review and alert level is essentially continuous and immediate.

Appendix B

PERIODIC INSPECTION PROGRAM FOR WHITE OAK DAM

I. PURPOSE

To provide periodic inspections of White Oak Dam in general accordance with the Federal Emergency Management Agency (FEMA) guidelines for dam safety and the Corps of Engineers guidelines for dam inspection.

II. REFERENCES

A. Federal Emergency Management Agency (June, 1979), "Federal Guidelines for Dam Safety," Federal Coordinating Council for Science, Engineering and Technology, Washington, D.C.

B. U. S. Army Corps of Engineers, "Recommended Guidelines for Safety Inspection of dams," 1973.

III. REQUIREMENTS

A. General Requirements

A formal inspection program shall be maintained which lists the features to be inspected, frequency of inspections, types of inspections, inspection schedule, and descriptions of required repairs.

B. Responsibilities

1) Inspection Schedule - A proposed schedule of informal, intermediate, and formal inspections is provided in Attachment 1.

2) Informal Inspections will be made ***quarterly*** at the White Oak Dam site under normal operating conditions, but weekly checks will be implemented if the lake elevation rises to 749 ft. or above. The weekly checks will continue for four weeks after the lake elevation returns to normal (approx. elevation 745 ft.). These informal inspections will be made by a team composed of representatives from ***LMER Engineering & Construction Management*** and from ***OECD***. A detailed checklist

(Attachment 2) has been prepared by a representative from ***LMER Engineering & Construction Management*** which includes the detection of (or changes in) seepage, piping, slope instability, settlement, cracking, and tilting.

3) Intermediate Inspections will be made ***by the Federal Energy Regulatory Commission (FERC)*** on an annual basis. This inspection will include a thorough field inspection and review of inspection records from and following the last ***intermediate*** inspection.

4) Formal Inspections will be made every five years and ***LMER Engineering & Construction Management*** will oversee the inspection team. The formal inspection will be ***conducted*** by ***an independent*** licensed professional engineer and will include site inspection, review of informal, intermediate, and formal inspection documents and a review to determine whether White Oak Dam meets the current accepted standards and practices.

5) Special Inspections will be made after the dam has been overtopped, if slope failure of the face of the dam occurs, or after any seismic event. ***LMER Engineering & Construction Management*** will oversee the special inspection team which will be directed by a licensed professional engineer.

6) Reports will be prepared after each inspection. Informal inspection reports will be transmitted each ***quarter*** within one week after the inspection to the **OECD** representative. Intermediate inspection reports will be transmitted by ***FERC to DOE/ORO*** following the annual inspection. Formal and special inspection reports will be transmitted within one month after the inspections have been completed. Copies of the ***informal***, formal, and special inspection reports will be transmitted to the ***LMER Engineering & Construction Management***, the LSS, the ***OECD*** representative, the DOE Program Manager for Emergency Management, the DOE Dam***s and Water Impoundments Program Coordinator, and DOE/ORNL Site Office.***

7) Corrective Actions - If unusual conditions are noted during an informal inspection, inspection team will be called in to evaluate the potential problem. A report will be prepared by the inspection team and will be transmitted as listed in item 6. Corrective actions will be taken to eliminate deficiencies noted during any inspection tour.

Attachment 1

PROPOSED INSPECTION SCHEDULE

Type of Inspection	Date Conducted	Report Transmitted
Informal	***Jan. 20 - 30** ***Apr. 20 - 30** ***July 20 - 31** ***Oct. 20 - 31**	1 week after inspection is completed
Intermediate ***(by FERC)***	****Sept., 1997** ****Sept., 1998** (etc.)	*
Formal	Summer ***1998*** Summer ***2003*** (etc.)	1 month after inspection is completed
Special	Whenever required	1 month after Inspection is completed

* ***Approximate dates***

** ***LMER will coordinate schedule with the FERC.***

Attachment 2

Check List for ***Quarterly*** Inspection
of White Oak Dam

I. GENERAL INFORMATION

Inspection Team:

Date:
Time:

Weather Conditions:
Temperature:
Pool Level:
Comments:

II. EMBANKMENT

A. CREST OF DAM

1. Condition of Surface:

2. Surface Cracks:

B. UPSTREAM SLOPE

1. Undesirable Growth or Debris

2. Erosion, Subsidence, Depressions or Surface Cracks:

3. Condition of Riprap:

C. DOWNSTREAM SLOPE

1. Undesirable Growth or Debris:

2. Erosion, Subsidence, Depressions or Surface Cracks:

3. Heaving or Abnormal Bulges:

4. Evidence of Seepage, Piping, or Boils:

5. Condition of Riprap:

D. CONTACT OF ENBANKMENT WITH ABUTMENTS

1. Evidence of Erosion, Springs, Seepage, etc.:

2. Comments:

III. AREA DOWNSTREAM OF EMBANKMENT, INCLUDING CHANNEL

A. Localized Subsidence, Erosion, Depressions, Surface Cracks:

B. Evidence of Seepage, Piping, or Boils:

C. Lush Growth or unusually Muddy Water in Channel:

IV. SPILLWAYS

A. SERVICE SPILLWAY

1. Condition of Gates:

2. Condition of Flume & Weir Structures:

B. EMERGENCY SPILLWAY / OLD CONCRETE CULVERT

1. General Condition:

2. Entrance & Exit to Culvert:

V. RESERVOIR CONDITIONS

A. General Conditions:

B. Recent Storm Events Affecting Reservoir Level:

VI. CONCLUSIONS

VII. RECOMMENDATIONS

APPENDIX C

CONTINGENCY PLAN FOR HIGH WATER LEVEL AT WHITE OAK DAM

I. PURPOSE

To provide a plan of action if the water level of White Oak Lake threatens the integrity of the dam or the safety of State Highway 95.

II. REFERENCES

A. Drumm, Eric and Bennett, Richard (April 1988), "Slope Stability Analysis of White Oak Dam, "Department of Civil Engineering, The University of Tennessee, Knoxville, TN.

B. "Emergency Events at White Oak Dam" EM-E2, 11-94.

C. "X-10 Site Emergency Plan" (ORNL/CF-91/71/R2), September 30, 1994.

D. "Notification of Operational Emergencies to Off-Site Officials" LS-35, 8-95.

E. Tschantz, Bruce (April 1987), "Hydrologic Hazard Analysis of White Oak Dam near Oak Ridge, Tenn., "Department of Environmental Engineering, The University of Tennessee, Knoxville, TN.

F. Syed B. Ahmed (January 1994), "White Oak Dam Stability Analysis," X-OE-708, Oak Ridge National Laboratory, Oak Ridge, TN.

G. U.S. Army Corps of Engineers (April 11, 1995)," Stability Analysis of White Oak Dam".

III. REQUIREMENTS

A. General Requirements

1. Lake level is transmitted to WOCC and LERC where alarms will be triggered corresponding to elevated and emergency flow levels.

2. The Laboratory Shift ***Superintendent*** (LSS) will monitor the ***lake level*** using the central computer and will activate the emergency response activities, as they are needed.

B. Responsibilities

1. If the flow rate recorded at the White Oak Dam weir reaches EL. 749, an alarm will be sent to the Waste Operations Control Center (WOCC) and LERC. The WOCC operator will call the LSS and inform him that their computer has indicated that White Oak Lake has an "elevated pool level" (approx. Lake elevation 749 ft). The LSS will log the call.

2. The LSS will access the central computer to look at the water level from White Oak Dam and will dispatch two representatives to the site. The LSS will classify the event as reportable and notify the ***EOC***, if necessary.

3. The LSS will dispatch two representatives to read the lake elevation from a staff gauge located on the side of the gate structure. If the gates are restricting the flow of water, the site representatives will open the gates to obtain maximum flow. The LSS will be notified of the actions taken and the present conditions at the dam.

4. If the elevation of White Oak Lake reaches 752 ft., the LSS will be alerted by the LSS representatives at the dam. The LSS will classify the event as an ***Operational Emergency*** and will activate the ***EOC***. The ***EOC*** will be assembled in the Emergency Operations Center and will follow procedures outlined in the ***"X-10 Site Emergency Plan"***. The ***EOC*** will evaluate the possibility and consequences of overtopping the dam.

5. If overtopping of the dam is imminent, the ***EOC*** will direct ORNL Security Patrol to set up barricades on State Highway 95, a safe distance from the dam, and route traffic away from the area. The ***EOC*** will request DOE to notify local law enforcement agencies to relieve ORNL Security Patrol at the road block sites. After the barricades have been set up, the LSS representatives will be directed to leave the site.

6. A special site inspection of the dam will be made by ***qualified engineers*** after the flood waters have subsided and before traffic is permitted to cross the dam. ***Concurrence of the State of Tennessee is required before traffic is allowed to resume.***

APPENDIX D

CONTINGENCY PLAN FOR MOVEMENT DETECTION AT WHITE OAK DAM

I. PURPOSE

To provide a plan of action in the event that movement of the dam crest or downstream berm is detected.

II. REFERENCES

A. Drumm, Eric and Bennett, Richard (April 1988), "Slope Stability Analysis of White Oak Dam," Department of Civil Engineering, The University of Tennessee, Knoxville, TN.

B. "Emergency Events at White Oak Dam" EM-E2, 11-94.

C. "X-10 Site Emergency Plan" (ORNL/CF-91/71/R2), September 30, 1994.

D. "Notification of Operational Emergencies to Off-Site Officials" LS-35, 8-95.

E. Tschantz, Bruce (April 1987), "Hydrologic Hazard Analysis of White Oak Dam near Oak Ridge, Tenn.," Department of Environmental Engineering, The University of Tennessee, Knoxville, TN.

F. Syed B. Ahmed (January 1994), "White Oak Dam Stability Analysis," X-OE-708, Oak Ridge National Laboratory, Oak Ridge, TN.

G. U.S. Army Corps of Engineers (April 11, 1995)," Stability Analysis of White Oak Dam".

III. REQUIREMENTS

A. General Requirements

1. The coordinates and elevations of the six engineering survey monuments located along the crest of White Oak Dam and the three additional monuments installed in the rock berm on the downstream face of the

dam will be checked ***once every six months***. More frequent checks will be made if the elevation of White Oak Lake rises to 749 ft. or above.

2. The LSS will be notified if movement of the monuments has been detected. The LSS will activate the emergency response activities, as they are needed.

B. Responsibilities

1. A survey crew will check the monuments for horizontal and vertical displacement ***once every six months under normal operating conditions.*** The "Procedures for Checking Survey Monuments at White Oak Dam" are provided in Attachment 1 to Appendix D.

2. If the water level in White Oak Lake rises to an elevation of 749 ft. or above, check of survey monuments will be made ***every other day*** by the survey crew for one week. The checks will then be reduced to once a week and then revert back to ***once every six months*** if NO ***significant*** movement has been detected.

3. The survey crew will document the results and report the findings.

4. If any ***significant*** movement of the monuments is detected, a follow up survey will be made on the same day to verify the surveying data. ***A qualified engineer*** will make a site visit and visually inspect the dam.

5. If NO ***significant*** movement is detected from the follow up survey, the survey monuments check will be made ***every other day*** by the survey crew for one week. The checks will then be reduced to once a week for four weeks and then revert back to ***once every six months*** if ***significant*** movement has not been detected.

6. If additional movement is detected, the ***LSS*** will be notified ***by LMER Engineering & Construction Management*** concerning the potential problem. The ***LSS*** will classify the event as an ***Operational Emergency*** and contact the ***EOC***.

7. A meeting of the ***EOC*** will be scheduled to determine the significance of the detected movement of the monuments and to determine what corrective actions should be taken. Qualified independent reviewers, will be contacted for their expert advice.

Attachment 1

PROCEDURES FOR CHECKING SURVEY MONUMENTS AT WHITE OAK DAM

At present, monuments are checked ***once every six months under normal operating conditions.*** The checks are taken from ORNL Control Monuments US-1 and DS-5 (these monuments are tied to the main plant control system). Monument US-1 is located on the side of a ridge southeast of the old box culvert about 100' south of culvert and 50' east of road and 20' higher in elevation in a well protected area. Monument DS-5 is located north of new spillway, approximately 400', near the south west corner of the boundary fence to SWSA 6, also well protected.

The survey instrument used for these surveys is a Geodimeter 104 total station purchased in 1984. The instrument uses an infrared beam for distance measurements. Angle measurements are made with the built-in theodolite. Accuracy of measurements are 0.01 ft. for distance and 0 0'2" sec. angular.

To make these measurements, a target (or prism) is used on a hand held rod (with built-in level). With rod adjusted to the height of the instrument, it is then placed on the sighted point, the instrument is then aimed at the target and measurements are taken and recorded.

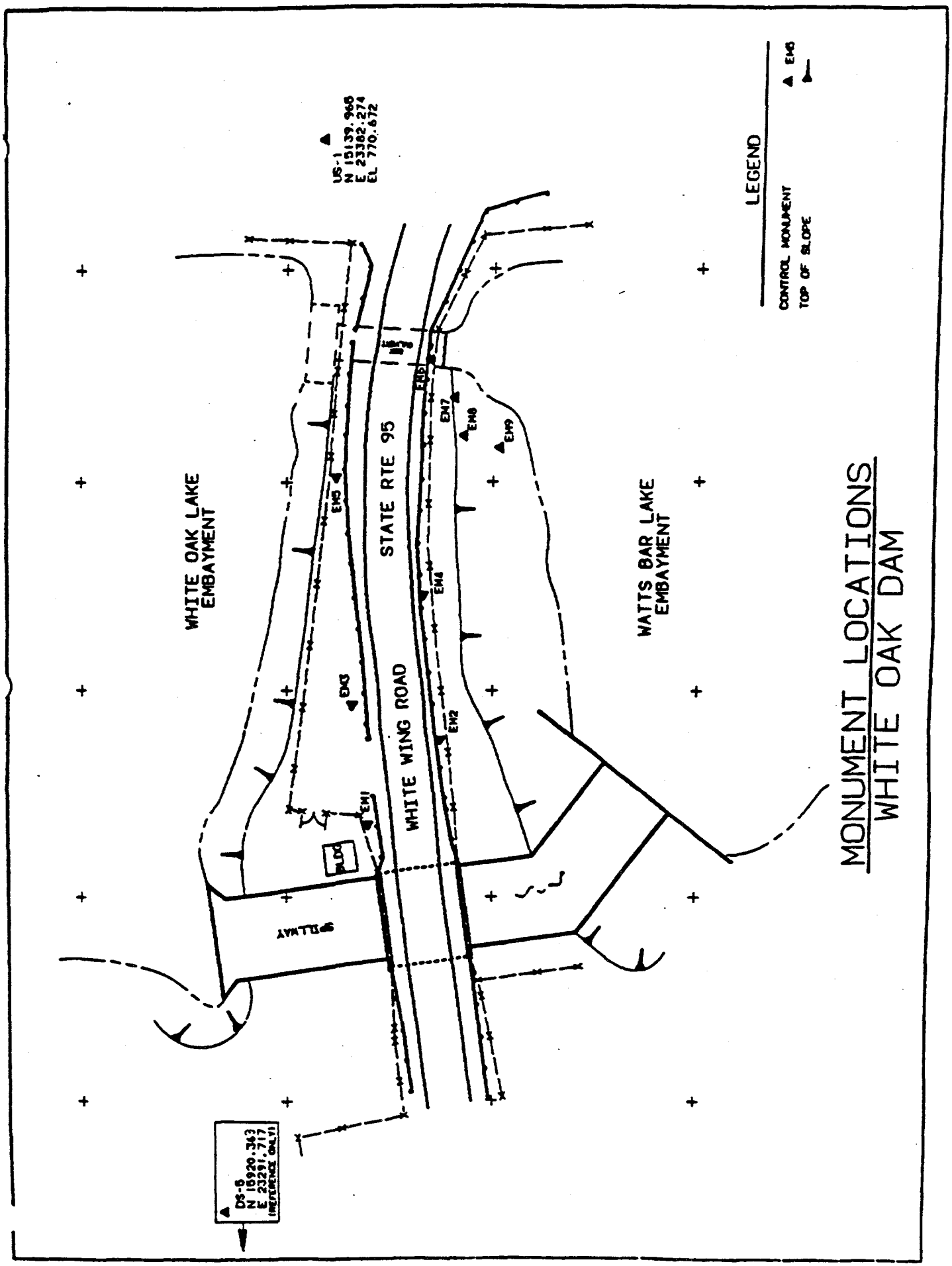
Surveys are usually performed with the instrument placed at Monument US-1 and with the backsight taken at Monument DS-5. (0 000'00" angle is set at the backsight with all angles being turned to the right.)

To date we have nine (9) monuments strategically placed along the crest of the dam and in the rock berm on the downstream side of the dam. These monuments are 8"-12" diameter placed to a depth of 24"-36" with steel rebar and ORNL aluminum monument caps on each one.

After the data is gathered, it is then reduced to X,Y,Z coordinates and then placed on a CADAM drawing plot for review by engineering supervision.

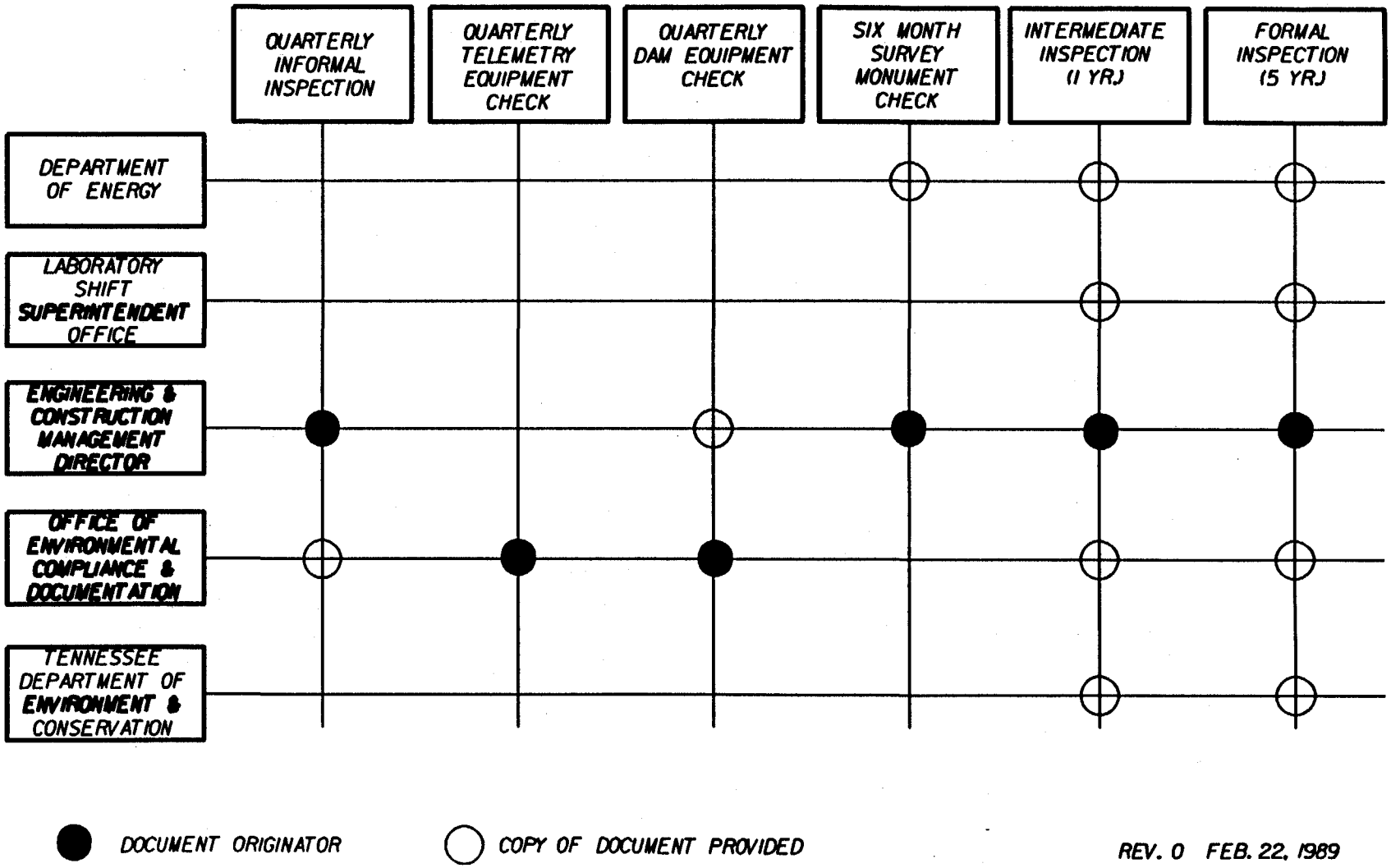
Control Monument Coordinates are:

US-1	DS-5
N 15139.965	N 15920.363
E 23382.274	E 23291.717
EL 770.672	EL 771.03


MONUMENT LOCATIONS
WHITE OAK DAM
LEGEND
CONTROL MONUMENT
TOP OF SLOPE
EM6
US-1
N 151139.966
E 23382.274
EL 770.672
WHITE OAK LAKE EMBAYMENT
STATE RTE 95
WHITE WING ROAD
WATTS BAR LAKE EMBAYMENT
EM1
EM2
EM3
EM4
EM5
EM7
EM8
EM9
SPILLWAY
DS-5
N 16920.343
E 23291.717
(REFERENCE ONLY)

APPENDIX E

DOCUMENTATION FLOW PATTERN
WHITE OAK DAM



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