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

LAS VEGAS OFFICE

301 E. Stewart Ave., Rm. 203
Las Vegas, NV 89101

FAX NO.: (702) 388-6128
Verify: (702) 388-6125

TO: Robert Johnson

FROM: PHILIP JUSTUS / JOHN GILRAY
Sr. On-Site Licensing Representatives' Office, Las Vegas, NV

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Attached is outline of TBM Construction Phase plan. ORs were briefed on this. We are preparing an Item of Interest.

This is a heads up - to be shared, as appropriate.

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TBM CONSTRUCTION PHASES

		Project Milestone Schedule	Target Schedule
A.	STARTUP TESTING PHASE		
•	C WALK TBM TO FACE	7/12/94	
•	S FIRST EXCAVATION TEST (0+60)	8/8/94	
•	S TWO SHIFT OPERATIONS, STATION 0+70	8/94	
B.	SHAKEDOWN PHASE		
•	S 7 DAY WORKWEEK (3 SHIFTS)	10/94	
	C ALCOVE #2, STATION 1+XX (10/94)*		
•	S EXCAVATE RAINIER MESA, STATION 1+90	9/94	
•	C EXCAVATE RAINIER MESA, STATION 2+60	10/94	
•	C MAPPING PLATFORM	1/95	12/94
	C ALCOVE #3, STATION 8+XX (5/95)*		
	C ALCOVE #4, STATION 10+XX (6/95)*		
C.	OPERATIONAL PHASE		
•	C CONVEYOR	6/95	2/95
	S NRG-6 INFLUENCE ZONE, STATION 17+XX		
	C DRILL HOLE WASH STRUCTURE, STATION 21+XX		
•	S NORTH RAMP EXT STUBOUT, STATION 21+XX	7/95	5/95
	C ALCOVE #5, STATION		
•	C NORTH RAMP, STATION 29+00	10/95	8/95

• - milestone
C - complete
S - start
* - variable depending on scientific need

EXPLORATORY STUDIES FACILITY PROGRESS

BACKGROUND

The Start-Up/Testing Phase of the 7.62-meter-in-diameter tunnel boring machine (TBM) is expected to begin August, 1994 at the Yucca Mountain Project's Exploratory Studies Facility (ESF) North Portal entrance.

Initial construction of the ESF's North Portal Pad began in November 1992. That was followed by the excavation of the 60-meter-long Starter Tunnel in April - September, 1993, using conventional drill and blast techniques. The Starter Tunnel will serve as a launching chamber for TBM operations. Once operations begin, the TBM will bore a tunnel through different rock formations in Yucca Mountain and will provide access for geologic mapping and development of test areas for scientific studies. When completed, the ESF will consist of a network of tunnels up to 25 kilometers in length, depending on the site characterization requirements of the project scientists.

A TBM is a special type of tunneling machine that breaks the rock into small pieces called muck with a rotating cutter head. The cutter head is electrically powered, while the propulsion of TBM is achieved through hydraulic jacks that grip the tunnel walls and move the machine forward. Muck is carried from the cutter to the rear of the machine and out of the tunnel through a series of conveyors. The TBM that will be used at Yucca Mountain was specially designed and built by Construction & Tunneling Services, Inc. of Kent, Washington.

In the last decade, the use of TBMs has become more common in heavy construction worldwide. These projects include the recently completed and opened rail tunnels beneath the English Channel, storm water tunnels for Chicago's Tunnel and Reservoir Project, and tunnels at the Nevada Test Site.

TBM PHASED OPERATIONS

Delivery of the TBM from Kent, Washington to Yucca Mountain began in April, 1994. Work crews are currently in the process of assembling the TBM on the North Portal Pad. Assembly is expected to be completed in July, 1994, at which time the TBM will be moved into the Starter Tunnel. Once the TBM has been emplaced within the Starter Tunnel, TBM operations will shift to a phased approach with three primary stages:

1. **Start-Up/Testing Phase** will include all operations from the time the TBM is placed within the tunnel, to the point where the TBM tests are completed.

2. **Shakedown Phase** will include operations from start-up, to the point when the conveyors become operational.

3. **Operational Phase** will begin when the conveyor system is fully operational.

The TBM also represents the assembly of a large amount of equipment into the confined space of the Starter Tunnel. In order for the TBM to function, a substantial amount of support equipment follows the main body of the TBM on rails much like a train. This "trailing gear" carries the electric power equipment and hydraulic systems necessary to excavate and remove rock and to advance the TBM.

In addition to this equipment, rock drills on the TBM and trailing gear will be used to install rock bolts for enhanced rock support as required during tunneling operations. Crews operating the TBM will also have the capability to install steel rings for added ground support and to apply a type of fast drying, sprayed-on concrete, called shotcrete. The trailing gear will also carry equipment which will allow detailed geologic mapping of the tunnel as the TBM advances.

ESF Testing

In addition to the mapping activities, scientific testing will be done in the ESF through a series of underground experiments, including the following examples:

Geomechanical testing will measure the rocks' response to pressure. Metal jacks will be set horizontally in a test alcove excavated off the main ESF tunnel, where they will apply force against the rock walls. Instrumentation will monitor the rock compression, and scientists will use this data to predict how excavation stresses will affect the rock.

Radial Borehole testing will measure water and vapor movement through the rock. Gasses will be pumped into injection boreholes, and any movement of the gases will be detected and tracked by electronic instrumentation placed in monitored boreholes. Scientists will use this data to predict how fluids will move through the rock beneath Yucca Mountain.

Thermal testing will measure how heat will affect the rock. Electric heaters will be used to heat the rock to temperatures simulating those that would be found in a repository environment. As instruments monitor the rock's response to the heat, engineers will test different design ideas for waste containers that could use the heat to keep a repository dry.

And finally, tests will focus on Zeolite Minerals and the potential movement of radioactive particles through the rock. These tests are planned for the Calico Hills, a rock formation filled with Zeolite Minerals, that are expected to act as a natural barrier to the movement of radioactive materials. During these tests, chemical tracers and water will be sprinkled on the rock. Sensors placed at the bottom of the rock will monitor the movement of the water and tracer through the rock.