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Study of a Conceptual Nuclear-Energy Center at Green River, Utah:

Site-Specific Transportation

by

NUS Corporation

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RELATED REPORTS

ORNL/Sub-79/55488/1, Preliminary Analysis of the Study of a Nuclear Energy Systems Complexes in the Western U.S., February 1978.

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TASK 5.2: SITE SPECIFIC TRANSPORTATION

5.2.1 INTRODUCTION

The objective of the following report is to assess the adequacy of the local and regional transportation network for handling traffic, logistics, and the transport of major power plant components to the Utah Nuclear Energy Center (UNEC) Horse Bench site. The discussion is divided into four parts: (1) system requirements; (2) description of the existing transportation network; (3) evaluation; (4) summary and conclusions.

5.2.2 SYSTEM REQUIREMENTS

An access road system will be required which can handle the construction traffic. On some multiple unit sites an oversize two lane road has been adequate to handle the traffic. A railroad spur wouid also be necessary to handle components and materials for construction and operational material needs.

Present-day nuclear steam generation and turbine-generator systems, and those anticipated for future use, involve the fabrication, transportation, and installation of very heavy, large components. Although the majority of light water reactor (LWR) components are readily transported by conventional means, some larger ones present special problems when considered for an inland location. These special problems will be addressed below. Other components such as steam turbines, although extremely large, pose no unique transportation problems as on-site assembly is currently a common and reliable method of fabrication.

Table 5.2-1 lists some characteristic sizes of large LWR components. A steam generator of one design for a Babcock & Wilcox pressurized water reactor is approximately 60 feet long and 13.5 feet in diameter and weighs in the range of 350 tons. Despite this bulk, transport across the country by a conventional rail system has been accomplished over carefully selected routes. In general, rail transport for such loads is limited to maximum grades of 1.5 percent, with reluctance of the rail companies to assume liability for transportation on grades exceeding 2 percent. In addition to the grade constraints, rights-of-way dimensional limitations may be imposed by facilities such as tunnels and bridge trestles. For loads as large as steam generators, the track curvature encountered must generally be greater than 225 feet. Load-bearing restrictions require a maximum of 60,000 lbs gross per axle on rail cars, and special cars are used.

Combustion Engineering and Westinghouse produce steam generators that are too large to ship to the Horse Bench site by rail because they are 22 feet and 16.5 feet in diameter respectively. Union Pacific and Denver and Rio Grande Western Railroad personel have advised that there is an approximately 14' width limitation on material shipped to the Green River area. For these larger designs the option of on site fabrication could double the cost for the steam generators.

Table 5.2-1

Characteristic Sizes of Light Water Reactor (LWR) Unit Components

Component	Width(ft)	Length(ft)	Net Weight(tons)
Steam Generators	13.5	60	350
Reactor Vessel	22	40	335
Reactor Head	22	10	90

Rail transportation of a complete 1,200-MWe-sized primary reactor vessel has not been attempted due to the combination of large dimensions and weights. When fully assembled, these vessels can reach 63 feet in length and 27 feet in diameter and can weigh more than 750 tons. Transportation in sections and onsite assembly has been used for Boiling Water Reactors (BWR) and is feasible Pressurized Water Reactors (PWR).

The largest component of a 1200-MWe electrical generator, the wound stator, is typically about 38 feet long and over 13 feet wide and weighs approximately 475 tons. The wound stator can be transported by rail using Schnabel cars, subject to the same restrictions on track grade, curvature, and clearance mentioned for steam generators.

5.2.3 DESCRIPTION OF THE EXISTING TRANSPORTATION NETWORK

The proposed UNEC Horse Bench site is located approximately 15 miles southwest of the town of Green River and approximately 6 miles west of the Green River. Access to the site can be obtained by taking Lower San Rafael Road from the town of Green River to the site. The Lower San Rafael Road is a county-maintained dirt road wide enough to permit two vehicles. Utah State Highway 24, a 2-lane oiled road, is about 10 miles to the west of the proposed site and serves as a link from Hanksville in Wayne County to U. S. Interstate Highway 70.

Rail access is provided at Green River by the Denver and Rio Grande Western Railroad, which operates Class I service through the area.

5.2.4 Evaluation

The Green River study area is evaluated below according to the system requirements outlined in Section 5.2.1.

Clearly, the use of waterborne transportation as a possible transit mode for major power plant components is not feasible. The Green River is navigable only for pleasure craft and the distance from the site to the nearest port with a potential for delivery without crossing a mountain range (Los Angeles-Long Beach) is over 700 miles.

Rail access is excellent as the Denver and Rio Grande Western Railroad has as its eastern and western junctions, Denver-Pueblo-Colorado and Provo-Salt Lake City-Ogden-Utah. Table 5.2-2 lists the railroad interconnections that can be made at these points. For very large and heavy components, the route probably would be through Provo-Salt Lake City-Ogden for connection with Union Pacific to Los Angeles or Kansas City. Utah Power and Light Company has recently shipped large components for coal-fired power plants by this route to western Emery County.

TABLE 5.2-2

Denver and Rio Grande Western Railroad Interconnection

Junctions	Other Carriers
Denver	Union Pacific; Santa Fe; Burlington Northern; Colorado Southern
Pueblo	Atchison, Topeka and Santa Fe; Missouri Pacific; Colorado Southern; Burlington Northern
Provo	Union Pacific (to Los Angeles)
Salt Lake City	Union Pacific (to Los Angeles); Western Pacific; Salt Lake and Garfield Western
Ogden	Union Pacific (to Idaho); Southern Pacific

Components delivered by rail to Green River could be transported to the Horse Bench site by a rail spur or overland on tracked or rubber-tired transporters. The terrain would not prevent either of these methods, but Lower San Raphael Road is inadequate for overland transport, and construction of at least a rudimentary road of adequate dimensions would be required for overland transport. For a nine-unit nuclear energy center, it is likely that both a railroad spur and a major highway connection would be built. The proposed route for the railroad and highway access is given in Figure 5.1-4 of the General Layout and Design study (Task 5.1). Presumably then, components would be delivered by rail directly to the site.

The feasibilty of transporting all the components for an NEC by rail is constrained by the dimensions of railroad tunnels, bridges, etc., and by the ability to ship in pieces and fabricate the largest components on the site.

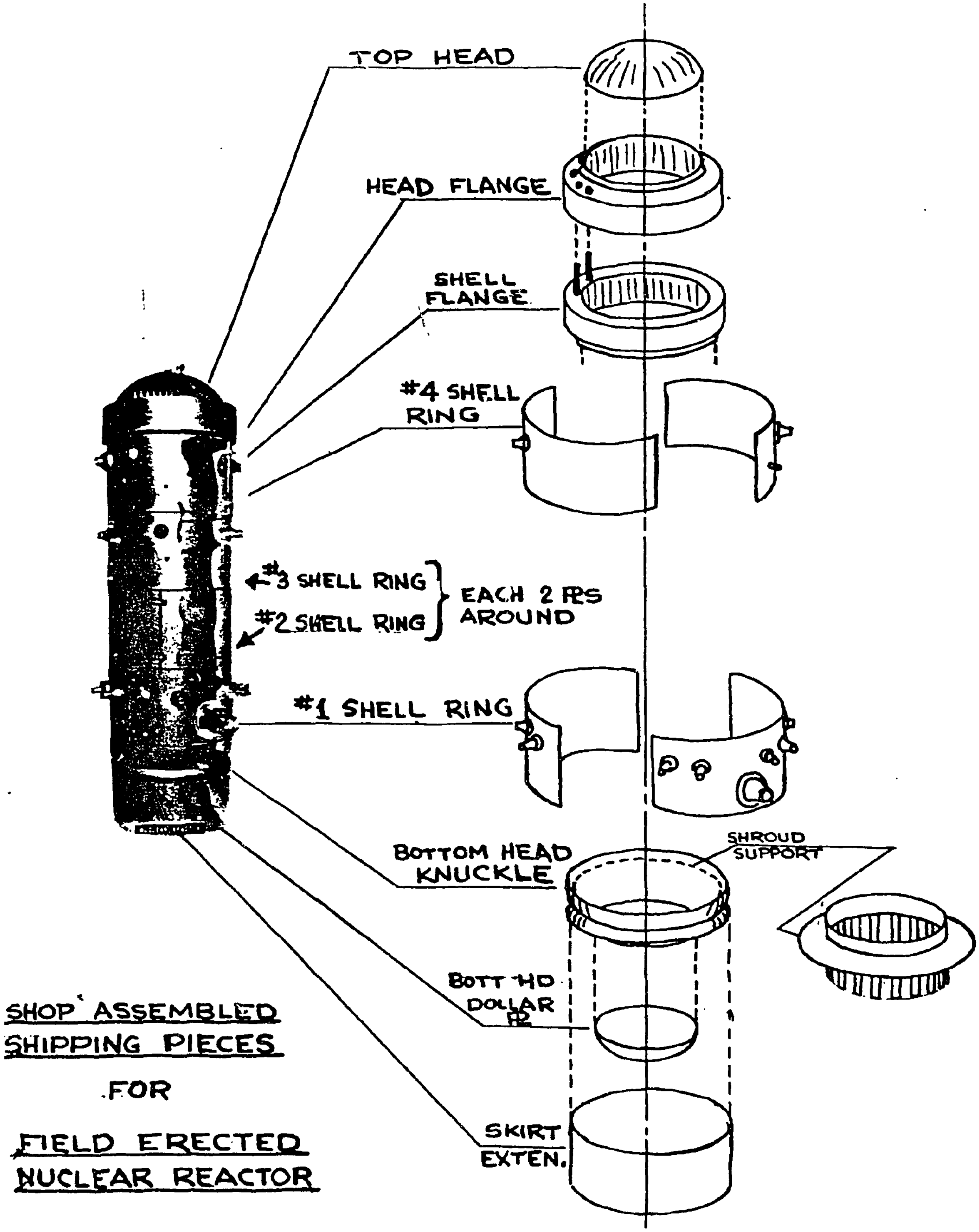
Preliminary discussions with representatives of the Denver and Rio Grande Western Railroad and the Union Pacific Railroad have indicated that weight, height, and width limitations are probably adequate to allow shipment from Kansas City or Los Angeles of items as large as the wound stator which would require an overall height of 17 feet 6 inches and a maximum width of 13 feet 3 inches (about 11 feet wide at 17 feet 6 inches). The railroad representatives were quick to point out that no commitments can be made without a detailed routing study. They also mentioned that the limiting dimensions we discussed are conservative, and that by using special Schnabel cars which can shift the load, additional clearance can be gained. Detailed route studies would be conducted for each piece of oversized equipment to be shipped using special sensor equipment which identifies constraining points. These detailed studies could be made after the choices of component designs are made. Perhaps the shipping dimensions will be one factor considered in making the choices on component designs.

The largest components, such as the reactor vessel, are simply too large to be shipped by conventional rail. On-site fabrication appears to be a reasonable alternative. For reactor vessels, representatives of Chicago Bridge and Iron Company indicate that on-site fabrication is feasible. They have experience in on-site construction of BWR reactors, and the technology is similar for PWR reactors. Figures 5.2-1 and 5.2.2 illustrate how typical BWR and PWR reactor vessels would be disassembled for shipment and eventual on-site fabrication. Fewer than 100 people would be required for on-site fabrication, and the work would be finished in less than one year per plant. Any required shop buildings, ovens, etc. would be furnished by the fabricator. Other large components, such as the core shroud could be easily redesigned so that rail shipping and on-site fabrication could be done. The on-site fabrication of steam generators does not appear to be a major problem, as several U.S. utilities have experience in on-site parts replacement. However the vendors have expressed some reluctance to attempt this task. The cost of on-site fabrication could double the cost as opposed to factory fabrication, but the transportation costs would be lower. The NEC concept would also generate some savings, since many problems would be solved once for all nine units.

5.2.5 SUMMARY AND CONCLUSIONS

The UNEC Horse Bench site is within a regional network of highway and railroad transporation that appears adequate to handle a project of this nature. The local access is presently inadequate and the project would require about 15 miles of new highway and a new railroad spur of similar length which are identified in Task 5.1, General Layout and Design.

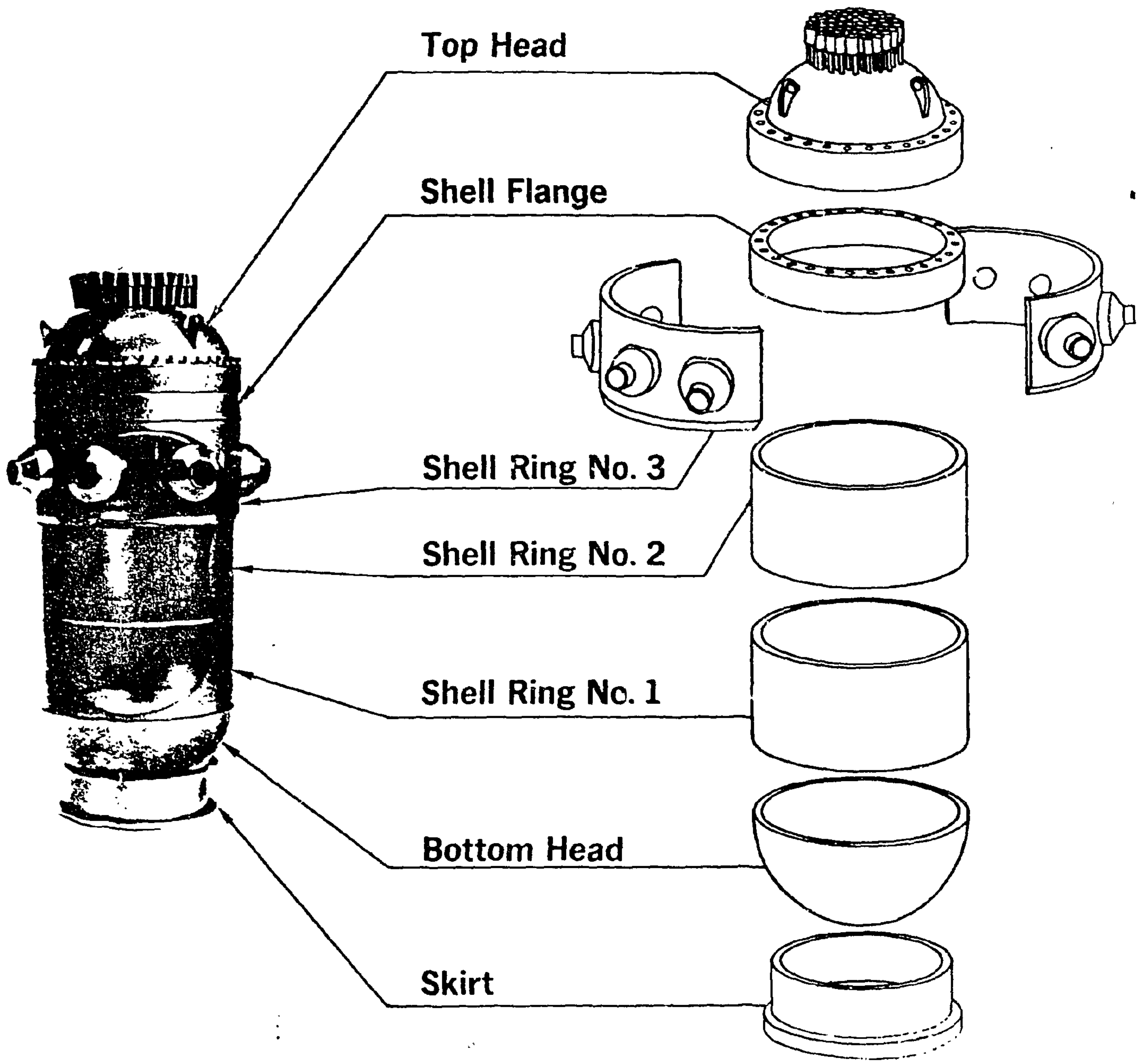
Preliminary discussions indicate that the transport of the components for the nuclear power plants by rail is feasible along existing routes from Kansas City or Los Angeles. Some components (reactor vessels, core shrouds, steam turbines, possibly steam generators) are too large to ship by conventional rail routes. These components can be shipped in pieces and fabricated on-site. The cost of on-site fabrication is estimated to be up to 1.5 times the cost of conventional fabrication, but transportation costs may be enough lower to offset part of the added cost.



Courtesy of Chicago Bridge & Iron Company

Figure 5.2-1

Shipping Pieces for Typical Boiling Water Reactor Vessel



Courtesy of Chicago Bridge & Iron Company

Figure 5.2-2

Proposed Shipping Pieces for
Typical Pressurized Water Reactor Vessel

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