CONTROL OF HEAVY LOADS AT NUCLEAR POWER PLANTS
VIRGIL C. SUMMER NUCLEAR STATION UNIT 1

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ABSTRACT

The Nuclear Regulatory Commission (NRC) has requested that all nuclear plants either operating or under construction submit a response of compliance with NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants." EG&G Idaho, Inc. has contracted with the NRC to evaluate the responses of those plants presently under construction. This report contains EG&G's evaluation and recommendations for the Virgil C. Summer Nuclear Station Unit 1.

EXECUTIVE SUMMARY

The Virgil C. Summer Nuclear Station Unit 1 does not totally comply with the guidelines of NUREG-0612. In general, additional evaluations are required in the following areas:

- Special Lifting Devices
- Slings

The main report contains recommendations which will aid in bringing the above items into compliance with the appropriate guidelines.

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TECHNICAL EVALUATION REPORT

FOR

VIRGIL C. SUMMER NUCLEAR STATION UNIT 1

1. INTRODUCTION

1.1 Purpose of Review

This technical evaluation report (TER) documents the EG&G Idaho, Inc. review of general load handling policy and procedures at South Carolina Electric & Gas Company's Virgil C. Summer Nuclear Station Unit 1. This evaluation was performed with the objective of assessing conformance to the general load handling guidelines of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants,"[1] Section 5.1.1.

1.2 Generic Background

Generic Technical Activity Task A-36 was established by the U.S. Nuclear Regulatory Commission (NRC) staff to systematically examine staff licensing criteria and the adequacy of measures in effect at operating nuclear power plants to ensure the safe handling of heavy loads and to recommend necessary changes to these measures. This activity was initiated by a letter issued by the NRC staff on May 17, 1978[2] to all power reactor licensees, requesting information concerning the control of heavy loads near spent fuel.

The results of Task A-36 were reported in NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants." The staff's conclusion from this evaluation was that existing measures to control the handling of heavy loads at operating plants, although providing protection from certain potential problems, do not adequately cover the major causes of load handling accidents and should be upgraded.

In order to upgrade measures for the control of heavy loads, the staff developed a series of guidelines designed to achieve a two-phase objective using an accepted approach or protection philosophy. The first portion of the objective, achieved through a set of general guidelines identified in NUREG-0612, Article 5.1.1, is to ensure that all load handling systems at nuclear power plants are designed and operated such that their probability of failure is uniformly small and appropriate for the critical tasks in which they are employed. The second portion of the staff's objective, achieved through guidelines identified in NUREG-0612, Articles 5.1.2 through 5.1.5 is to ensure that, for load handling systems in areas where their failure might result in significant consequences, either (1) features are provided, in addition to those required for all load handling systems, to ensure that the potential for a load drop is extremely small (e.g., a single failure-proof crane) or (2) conservative evaluations of load handling accidents indicate that the potential consequences of any load drop are acceptably small. Acceptability of accident consequences is quantified in NUREG-0612 into four accident analysis evaluation criteria.

The approach used to develop the staff guidelines for minimizing the potential for a load drop was based on defense-in-depth and is summarized as follows:

- Provide sufficient operator training, handling system design, load handling instructions, and equipment inspection to ensure reliable operation of the handling system.

- Define safe load travel paths through procedures and operator training so that, to the extent practical, heavy loads are not carried over or near irradiated fuel or safe shutdown equipment.

- Provide mechanical stops or electrical interlocks to prevent movement of heavy loads over irradiated fuel or in proximity to equipment associated with redundant shutdown paths.

Staff guidelines resulting from the foregoing are tabulated in Section 5 of NUREG-0612.

1.3 Plant-Specific Background

On December 22, 1980, the NRC issued a letter[3] to South Carolina Electric & Gas Company, the Licensee for Virgil C. Summer Nuclear Station Unit 1 requesting that the Licensee review provisions with respect to the guidelines of NUREG-0612, and provide certain additional information to be used for an independent determination of conformance to these guidelines. On June 26, 1981, South Carolina Electric & Gas Company provided the initial response[4] to this request.

2. EVALUATION AND RECOMMENDATIONS

2.1 Overview

The following sections summarize South Carolina Electric & Gas Company's review of heavy load handling at Virgil C. Summer Nuclear Station Unit 1 accompanied by EG&G's evaluation, conclusions and recommendations to the Licensee for bringing the facilities more completely into compliance with the intent of NUREG-0612. The Licensee has indicated the weight of a heavy load for this facility (as defined in NUREG-0612, Article 1.2) as 2500 pounds.

2.2 Heavy Load Overhead Handling Systems

This section reviews the Licensee's list of overhead handling systems which are subject to the criteria of NUREG-0612 and a review of the justification for excluding overhead handling systems from the aforementioned list.

2.2.1 Scope

Report the results of the Licensee's review of plant arrangements to identify all overhead handling systems from which a load drop may result in damage to any system required for plant shutdown or decay heat removal (taking no credit for any interlocks, technical specifications, operating procedures, or detailed structural analysis) and justify the exclusion of any overhead handling system from your list by verifying that there is sufficient physical separation from any load-impact point and any safety-related component to permit a determination by inspection that no heavy load drop can result in damage to any system or component required for plant shutdown or decay heat removal.

2.2.1.1 Summary of Licensee Evaluation on Overhead Handling Systems

The Licensee's review of overhead handling systems identified the cranes and hoists shown in Table 2.1 as those which handle heavy loads in the vicinity of irradiated fuel or safe shutdown equipment.

In Table 2.2, the Licensee has identified other cranes that have been excluded from satisfying the criteria of the general guidelines of NUREG-0612. These various overhead handling devices were reviewed by the Licensee to the criteria of NUREG-0612 and were excluded based on sufficient physical separation from any load-impact point that could damage any system or component required for plant shutdown or decay heat removal. Some of the devices have been excluded because the Licensee has indicated that the heavy load of 2500 pounds for this facility would not be exceeded.

2.2.1.2 EG&G Evaluation, Conclusions and Recommendations for Overhead Handling Systems

The Licensee's response indicates that each overhead handling device at the Virgil C. Summer Nuclear Station Unit 1 is listed in Tables 2.1 and 2.2. Figures 1 through 11 of Reference 5 show the locations of all the overhead handling systems in the plant and their proximity to safety-related components. EG&G concludes that the Licensee's list of cranes and hoists in the aforementioned tables is complete and satisfies the requirements of NUREG-0612.

TABLE 2.1 OVERHEAD HANDLING DEVICES IN VICINITY OF SAFE SHUTDOWN EQUIPMENT
VIRGIL C. SUMMER NUCLEAR STATION UNIT 1

Crane I.D.	Crane Type	Heavy Loads Handled and Lifting Device	Load Weight
XCR-1	Reactor Cavity Manipulator Crane	Spent and New Fuel Assembly and Handling Tool	2500 lbs
XCR-2 & XCR-16	Spent Fuel Pit Bridge Crane	Spent Fuel Assembly and Handling Tool	2500 lbs
XCR-49	Fuel Handling Building, Fuel Transfer Canal Gate Hoist	Fuel Transfer Canal Gates and Two-Part Sling	4500 lbs
XCR-4	Reactor Building Polar Crane	a) CRDM Missile Shields	54,000 lbs
		b) Upper Internals and Internals Lifting Rig	92,000 lbs
		c) Lower Internals and Internals Lifting Rig	268,000 lbs
		d) Internals Lifting Rig	19,000 lbs
		e) ISI Tool and Vendor-Supplied Lifting Device	20,000 lbs
		f) RCP Internals	48,000 lbs
		g) RCP Casing and Lifting Beam	52,000 lbs
		h) RCP Motor	77,140 lbs
		i) RV Studs, Nuts, and Washer Stand	8,500 lbs
		j) Equipment Bridge	4,000 lbs
		k) Reactor Vessel Head Assembly, Lifting Rig, and Sling	143,500 lbs
		l) Reactor Vessel Head Lifting Rig	21,000 lbs
XCR-23A & XCR-23B	2-ton Manual Chain Hoist and Trolley	a) RB Spray Sump Isolation Valve Protective Chambers	Top 3000 Complete 9000 lbs

TABLE 2.1 Continued

Crane I.D.	Crane Type	Heavy Loads Handled and Lifting Device	Load Weight
		b) SI Recirculation Sumps Isolation Valves Protective Chambers	Top 3000 Complete 9000 lbs
XCR-36	20-ton Electric Cable Hoist and Trolley	Radwaste Facility Equipment	Less than or equal to max. capacity
XCR-40A, XCR-40B, XCR-40C	10-ton Hand Chain Hoists and Trolleys	Main Steam Isolation Valves	21,000 lbs
XCR-46	3-ton Bridge Crane	a) Concrete Plugs	1770 lbs
		b) Filters and Cartridges	Negligible
		c) Storage Casks	2590 lbs
XCR-47	10-ton Bridge Crane	Hot Machine Shop and Low Level Waste Storage	Less than or equal to max. capacity
XCR-50 & XCR-51	10-ton Bridge Crane and Hoist	a) Service Water Traveling Screen	27,939 lbs
		b) Service Water Pump	14,000 lbs
		c) Service Water Pump Motor	15,650 lbs
XRW-13	3-ton Jib Crane	a) Concrete Plugs	1770 lbs
		b) Spent Filters and Cartridges	Negligible
		c) Storage Casks	2590 lbs
		d) Lifting Beam	1350 lbs

TABLE 2.2 OVERHEAD HANDLING DEVICES EXCLUDED
FROM FURTHER CONCERN
VIRGIL C. SUMMER NUCLEAR STATION UNIT 1

Crane I.D.	Crane Type	Heavy Loads Handled and Lifting Device	Load Weight
XCR-3	Fuel Handling Building Crane	a) New Fuel Shipping Container and Vendor-Supplied Lifting Device	6600 lbs
		b) Spent Fuel Shipping Cask and Vendor-Supplied Lifting Device	(later)
		c) Irradiated Specimen Shipping Cask and Vendor-Supplied Lifting Device	(later)
XCR-45	Fuel Handling Building, New Fuel Elevator Winch	NA (Not overhead handling device)	NA
XCR-17	Turbine Building Crane	General Electric Turbine Generator and Associated Power Plant Equipment	Less than or equal to max. capacity
XCR-18	10-ton Cable Hoist and Trolley	Power Plant Equipment	Less than or equal to max. capacity
XCR-19	7.5-ton Electric Cable Hoist and Trolley	Power Plant Equipment	Less than or equal to max. capacity
XCR-20A & XCR-20B	5-ton Hand Chain Hoist and Trolley	a) RHR Pumps b) RHR Pump Motor	4400 lbs 3200 lbs
XCR-21A & XCR-21B	5-ton Manual Chain Hoist and Trolley	a) RB Spray Pumps b) RB Spray Pump Motors	5400 lbs 5880 lbs

TABLE 2.2 (Continued)

Crane I.D.	Crane Type	Heavy Loads Handled and Lifting Device	Load Weight
XCR-54A, XCR-54B, & XCR-54C	5-ton Manual Chain Hoist and Trolley	SI Charging Pumps	
		a) Pump	7500 lbs
		b) Base	6000 lbs
		c) Gear	2100 lbs
		d) Motor	6700 lbs
XCR-24	8-ton Hand Chain Hoist and Trolley	Main Steam Stop Valves	Less than or equal to max. capacity
XCR-25A, XCR-25B, XCR-25C, & XCR-25D	10-ton Hand Hoist and Trolley	Main Condenser Water Boxes (2 Cranes per Water Box)	26,500 lbs
XCR-26	4-ton Hand Chain Hoist and Trolley	Feedwater Booster Pumps	
		a) Pump	7800 lbs
		b) Driver	8500 lbs
		c) Bedplate	5900 lbs
XCR-27	5-ton Electric Cable Hoist and Trolley	Power Plant Equipment	Less than or equal to max. capacity
XCR-28	2-ton Electric Cable Hoist and Trolley	Chemical Storage Containers	Less than or equal to max. capacity
XCR-29A, XCR-29B	2-ton Hand-Operated Hoist and Trolley	Generator Parts	Less than or equal to max. capacity
XCR-31	1/2-ton Hand Chain Hoist and Trolley	Under heavy load limit	NA
XCR-33	2-ton Hand Chain Hoist and Trolley	Turbine-Driven Emergency Feedwater Pump	
		a) Pump	3000 lbs
		b) Base	2400 lbs
		c) Driver	3260 lbs

TABLE 2.2 (Continued)

Crane I.D.	Crane Type	Heavy Loads Handled and Lifting Device	Load Weight
XCR-34	1-ton Electric Cable Hoist and Trolley	Under heavy load limit	NA
XCR-42	10-ton Bridge Crane	Hot Machine Shop Applications	Less than or equal to max. capacity
XCR-43	10-ton Bridge Crane	Service Building Applications	Less than or equal to max. capacity
XCR-48	1-1/2-ton Hand Chain Hoist and Trolley	Instrument and Service Air Compressors	Less than or equal to max. capacity
XCR-53A, XCR-53B, XCR-53C	2-ton Twin Hook Extension Hoists	CRDM Cable Support Structures	NA
XRW-11	1-ton Jib Crane	Under heavy load limit	NA
	Reactor Building Equipment Access Hatch Door	Equipment Hatch	NA

The Licensee performed a review of the various overhead handling devices to the criteria of NUREG-0612 by a physical inspection of the plant and by studying up-to-date layout drawings. For those devices which were excluded, the Licensee has provided justification that indicates sufficient physical separation exists between components necessary for safe shutdown or decay heat removal and load-impact points. EG&G concludes that the Licensee has met the requirements of NUREG-0612 concerning exclusion of overhead handling systems.

2.2.1.3 Summary on Heavy Load Overhead Handling Systems

The Virgil C. Summer Nuclear Plant Unit 1 complies with the criteria of NUREG-0612 on Heavy Load Overhead Handling Systems.

2.3 General Guidelines

This section addresses the extent to which the applicable handling systems comply with the general guidelines of NUREG-0612, Article 5.1.1. EG&G's conclusions and recommendations are provided in summaries for each guideline.

The NRC has established seven general guidelines which must be met in order to provide the defense-in-depth approach for the handling of heavy loads. These guidelines consist of the following criteria from Section 5.1.1 of NUREG-0612:

Guideline 1--Safe Load Paths
Guideline 2--Load Handling Procedures
Guideline 3--Crane Operator Training
Guideline 4--Special Lifting Devices

Guideline 5--Lifting Devices (not specially designed)
Guideline 6--Cranes (Inspection, Testing, and Maintenance)
Guideline 7--Crane Design.

These seven guidelines should be satisfied for all overhead handling systems and programs in order to handle heavy loads in the vicinity of the reactor vessel, near spent fuel in the spent fuel pool, or in other areas where a load drop may damage safe shutdown systems. The succeeding paragraphs address the guidelines individually.

2.3.1 Safe Load Paths [Guideline 1, NUREG-0612, Article 5.1.1(1)]

Safe load paths should be defined for the movement of heavy loads to minimize the potential for heavy loads, if dropped, to impact irradiated fuel in the reactor vessel and in the spent fuel pool, or to impact safe shutdown equipment. The path should follow, to the extent practical, structural floor members, beams, etc., such that if the load is dropped, the structure is more likely to withstand the impact. These load paths should be defined in procedures, shown on equipment layout drawings, and clearly marked on the floor in the area where the load is to be handled. Deviations from defined load paths should require written alternative procedures approved by the plant safety review committee.

2.3.1.1 Summary of Licensee's Evaluations of Safe Load Paths

Inside the Reactor Building, the Licensee has identified areas where cranes XCR-4, XCR-53A, XCR-53B, XCR-53C, and the Reactor Building equipment access hatch crane can be safely operated without damaging vital plant components or releasing radioactive material to the environment. In other areas, cranes XCR-1 and XCR-34 must operate where a safe load path

cannot be defined. For these two cases, the Licensee is developing procedures to protect vital components or mitigate radioactive releases due to an inadvertent load drop. Figures 4, 5, and 6 of Reference 5 describe the safe load path areas for the Reactor Building cranes.

In the Fuel Handling Building area, cranes XCR-2 and XCR-16 operate over the spent fuel pit where a safe load path cannot be defined. The operation of these cranes are governed by the Westinghouse Refueling Procedures which are currently being reviewed and placed into a standard format. Cranes XCR-3, XCR-45, and XCR-49 do have safe load paths defined and are shown on Figures 5 and 7 of Reference 5.

The Turbine Building cranes XCR-17, XCR-24, XCR-25A, XCR-25B, XCR-25C, XCR-25D, XCR-26, and XCR-48 have safe load paths defined in the various figures of Reference 5. All have been excluded from further study or concern by the Licensee.

The Licensee has defined safe load paths for the Auxiliary Building cranes in the figures of Reference 5 and have excluded them from further study or concern with the exception of XCR-23A, XCR-23B, and XCR-46. These three cranes could affect safe shutdown equipment or radioactive releases. In this instance, procedures are being developed to preclude an inadvertent heavy load drop.

In the Intermediate Building, the cranes have safe load paths depicted in the figures of Reference 5 and are excluded from further study or concern with the

exception of chain hoists XCR-40A, XCR-40B, and XCR-40C. These chain hoists service the main steam isolation valves and preliminary study has shown that a dropped valve could deform the floor at point of impact. Consequently, the Licensee is writing procedures to minimize the effects of an inadvertent valve drop.

Cable hoist XCR-28, in the Water Treatment Building, has a safe load path defined in Figure 1 of Reference 5 and is excluded from further study or concern as there are no components necessary for safe shutdown or for decay heat removal in the area.

For the Diesel Generator Building, hoists XCR-29A and XCR-29B have safe load paths shown in Figure 4 of Reference 5. The Licensee has chosen to exclude these cranes from further study or concern because of the redundancy of the diesel generator system.

The cranes located in the Drumming Station have safe load paths defined in Figure 4 of Reference 5. Hoist XCR-36 is used to handle low and high level radiation shipping casks and, even though an inadvertent drop could result, no damage would occur to the floor or the spent fuel pit cooling pumps below. However, the Licensee is preparing procedures to prevent dropping of a radwaste cask and minimize potential hazards. Crane XCR-47 is used to handle shielded and unshielded low level waste storage containers and the Licensee is preparing procedures to ensure safe handling of the containers. Jib crane XRW-11 is excluded from further study as its rated capacity is under heavy load limit. Jib crane XRW-13, in the same area as

hoist XCR-36, is used to handle spent filters and their storage casks. The Licensee is developing procedures to ensure proper handling of these filters to minimize possibility of an inadvertent load drop.

Hot Machine Shop crane XCR-42 has a safe load path depicted in Figure 4 of Reference 5. The Licensee has excluded this crane as no components necessary for safe shutdown or decay heat removal is located in the area.

Crane XCR-43 in the Service Building has a safe load path shown in Figure 1 of Reference 5. This crane is excluded from further study or concern because the Service Building does not contain equipment necessary for safe shutdown or decay heat removal.

In the Service Water Intake Screen and Pump House, cranes XCR-50 and XCR-51 are used for the service water pumps and have a safe load path shown in Figure 8 of Reference 5. The Licensee is developing procedures to ensure that the cranes do not travel over an operating service water pump.

2.3.1.2 EG&G Evaluations, Conclusions and Recommendations on Safe Load Paths

For those overhead handling devices which have safe load paths, the Licensee has prepared equipment layout drawings identifying the safe load paths. When no safe load path can be defined, the Licensee is preparing procedures to govern the operation and use of the devices.

The Licensee has also indicated that safe load paths will be permanently marked on the walls or floor of the plant. Upon completion of the aforementioned procedures, the Licensee should have them available for possible NRC review.

EG&G concludes that the Licensee is complying with the requirements of Guideline 1, Safe Load Paths, NUREG-0612.

2.3.1.3 Summary on Safe Load Paths

The Virgil C. Summer Nuclear Plant Unit 1 fully complies with the criteria of Guideline 1, "Safe Load Paths," NUREG-0612, by defining safe load paths in procedures, by providing equipment layout drawings showing safe load paths, and by marking load paths on floors or walls in the area where the loads are to be handled. Special procedures should be completed prior to fuel load.

2.3.2 Load Handling Procedures [Guideline 2, NUREG-0612, Article 5.1.1(2)]

Procedures should be developed to cover load handling operations for heavy loads that are or could be handled over or in proximity to irradiated fuel or safe shutdown equipment. As a minimum, procedures should cover handling of those loads listed in Table 3-1 of NUREG-0612. These procedures should include: identification of required equipment, inspections and acceptance criteria required before movement of load, the steps and proper sequence to be followed in handling the load, defining the safe load path, and other special precautions.

2.3.2.1 Summary of Licensee's Evaluation on Load Handling Procedures

The Licensee is developing procedures for handling heavy loads with overhead handling devices. Presently, the Licensee is developing maintenance procedures to encompass overhead handling systems with respect to the safe load paths. Where safe load paths could not be defined, special lifting procedures are being developed and where possible, special lifting instructions are incorporated into specific component maintenance procedures.

2.3.2.2 EG&G Evaluations, Conclusions and Recommendations on Load Handling Procedures

With the Licensee preparing the necessary load handling procedures, EG&G considers the criteria of Guideline 2 will be accomplished. Those items delineated in the guideline concerning identification of the required equipment, inspections and acceptance criteria required before movement of load, steps and proper sequence in handling the load, defining the safe load path and other special precautions should be specifically addressed in the Licensee's procedures, where applicable. When the procedures are completed, the Licensee should have them available for possible NRC review.

2.3.2.3 Summary on Load Handling Procedures

The Licensee will comply with the criteria of Guideline 2, NUREG-0612, upon completion of the load handling procedures prior to fuel load.

2.3.3 Crane Operator Training [Guideline 3, NUREG-0612, Article 5.1.1(3)]

Crane operators should be trained, qualified and conduct themselves in accordance with Chapter 2-3 of ANSI B30.2-1976, "Overhead and Gantry Cranes."[6]

2.3.3.1 Summary of Licensee's Evaluation of Crane Operator Training

The Licensee conducts an extensive training program for its crane operators and riggers which meets or exceeds all the requirements of Chapter 2-3 of ANSI B30.2. The Maintenance Group conducts a program for the crane operators and riggers entitled "Basic Operator and Rigger Training Program." The crane operator and rigger training programs include in-class written examinations and in-plant examinations for practical application. After a crane operator or rigger becomes qualified by the training program, an annual physical examination and a biannual retraining and requalification of the crane operators and riggers are required.

2.3.3.2 EG&G Evaluation, Conclusions and Recommendations on Crane Operator Training

The Licensee has met the criteria of this guideline for training, qualification and conduct as specified by Chapter 2-3 of ANSI B30.2-1976.

EG&G recommends the Licensee review the procedures from Guideline 2 and provide training to permit complete familiarization of the procedures prior to their use, especially those infrequently used.

2.3.3.3 Summary on Crane Operator Training

The Licensee complies with the criteria of Guideline 3, NUREG-0612, in which Crane Operators are trained and qualified in accordance with Chapter 2-3 of ANSI B30.2-1976, "Overhead and Gantry Cranes."

2.3.4 Special Lifting Devices [Guideline 4, NUREG-0612, Article 5.1.1(4)]

Special lifting devices should satisfy the guidelines of ANSI N14.6-1978, "Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More for Nuclear Materials."[7] This standard should apply to all special lifting devices which carry heavy loads in areas as defined above. For operating plants certain inspections and load tests may be accepted in lieu of certain material requirements in the standard. In addition, the stress design factor stated in Section 3.2.1.1 of ANSI N14.6 should be based on the combined maximum static and dynamic loads that could be imparted on the handling device based on characteristics of the crane which will be used. This is in lieu of the guideline in Section 3.2.1.1 of ANSI N14.6 which bases the stress design factor on only the weight (static load) of the load and of the intervening components of the special handling device.

2.3.4.1 Summary of Licensee's Evaluation on Special Lifting Devices

The Licensee's lifting devices do not comply with ANSI N14.6-1978. It is proposed that alternate methods for demonstration of equivalency are provided by a detailed inspection and testing program. The Licensee is developing maintenance procedures to

perform frequent and periodic inspection, which include visual and non-destructive examination of critical surfaces. Periodic load tests will be performed as necessary to verify structural adequacy of the special lifting devices. All rigging and lifting devices are controlled and maintained using the plant's computerized preventative maintenance program. The Licensee's existing inspection and maintenance procedures are outlined in the plant's Mechanical Maintenance Procedure MMP-165.8, "Use and Control of Rigging Equipment."

2.3.4.2 EG&G Evaluation, Conclusion and Recommendations on Special Lifting Devices

The proposed inspection and testing program for special lifting devices partially fulfills the requirements of this guideline. The Licensee should provide a design analysis including static and dynamic loads for all special handling devices especially those used for critical loads. The stress design factors should be addressed in the analysis. All other aspects of ANSI N14.6 should be addressed by the Licensee in their report.

2.3.4.3 Summary on Special Lifting Devices

In order to complete compliance with the criteria of Guideline 3, the Licensee should perform the following:

(a) A design analysis of the special lifting devices using the stress design factors for dynamic and static loads showing that these devices meet ANSI N14.6.

(b) Provide analysis for those special handling devices that are considered for critical loads.

(c) Fabrication records should be retrieved and examined for ANSI N14.6 compliance.

(d) Acceptance testing of the special handling devices should be examined per ANSI N14.6 criteria.

(e) All special handling devices will require a load test per ANSI N14.6.

2.3.5 Lifting Devices (Not Specially Designed) [Guideline 5, NUREG-0612, Article 5.1.1(5)]

Lifting devices that are not specially designed should be installed and used in accordance with the guidelines of ANSI B30.9-1971, "Slings."[8] However, in selecting the proper sling, the load used should be the sum of the static and maximum dynamic load. The rating identified on the sling should be in terms of the "static load" which produces the maximum static and dynamic load. Where this restricts slings to use on only certain cranes, the slings should be clearly marked as to the cranes with which they may be used.

2.3.5.1 Summary of Licensee's Evaluation on Lifting Devices (Not Specially Designed)

The Licensee's lifting devices do not comply with ANSI B30.9-1971. It is indicated that inspection and testing will provide the reliability needed for slings.

2.3.5.2 EG&G Evaluation, Conclusions and Recommendations on Lifting Devices (Not Specially Designed)

EG&G finds the use of slings that do not comply with ANSI B30.9 as unacceptable. The Licensee should comply with this guideline and ANSI B30.9. If the slings in the Licensee's possession can be proof tested to the load rating based on static and dynamic load in accordance with ANSI B30.9, then by using appropriate markings, those slings can be designated for a particular service.

All the lifting devices for the plant should be installed and used in accordance with ANSI B30.9. The ratings identified on the sling should be in terms of the "static load" which produces the maximum static and dynamic load. Where slings are restricted to use on certain cranes, then the slings should be clearly marked to indicate with which cranes they may be used.

EG&G suggests that the Licensee could select slings for lifts based on the next higher sling rating. This action would preclude the Licensee from accumulating slings for specific lifts and would also simplify compliance with ANSI B30.9-1971.

2.3.5.3 Summary on Lifting Devices (Not Specially Designed)

In order to comply with the requirements of this guideline, the Licensee should perform the following prior to fuel load:

(a) Assure that slings for the plant are installed and used in accordance with ANSI B30.9.

(b) Proof testing should be done to the load rating based on static and dynamic load.

(c) Slings should be marked in terms of the static load which produces the maximum static and dynamic load.

(d) When slings are restricted to certain cranes, they should be marked accordingly.

2.3.6 Cranes (Inspection, Testing and Maintenance) [Guideline 6, NUREG-0612, Article 5.1.1(6)]

The crane should be inspected, tested, and maintained in accordance with Chapter 2-2 of ANSI B30.2-1976, "Overhead and Gantry Cranes," with the exception that tests and inspections should be performed prior to use where it is not practical to meet the frequencies of ANSI B30.2 for periodic inspection and test, or where frequency of crane use is less than the specified inspection and test frequency (e.g., the polar crane inside a PWR containment may only be used every 12 to 18 months during refueling operations, and is generally not accessible during power operation). ANSI B30.2, nowever, calls for certain inspections to be performed daily or monthly. For such cranes having limited usage, the inspections, test, and maintenance should be performed prior to their use.

2.3.6.1 Summary of Licensee's Evaluation on Cranes (Inspection, Testing and Maintenance)

The Licensee's cranes and rigging equipment are maintained, tested and inspected to the requirements of ANSI B30.2, Chapter 2-2, by the plant's computerized history and maintenance program.

2.3.6.2 EG&G Evaluation, Conclusions and Recommendations on Cranes (Inspection, Testing and Maintenance)

It appears to EG&G that the Licensee meets the criteria of NUREG-0612 for inspection, testing and maintenance of their cranes and rigging equipment. Documentation on inspection, testing, and maintenance should be available for NRC review.

2.3.6.3 Summary on Cranes (Inspection, Testing and Maintenance)

The Licensee complies with the criteria of Guideline 6, NUREG-0612, in which their cranes and rigging equipment are inspected, tested and maintained in accordance with Chapter 2-2 of ANSI B30.2-1976.

2.3.7 Crane Design [Guideline 7, NUREG-0612, Article 5.1.1(7)]

The crane should be designed to meet the applicable criteria and guidelines of Chapter 2-1 of ANSI B30.2-1976, "Overhead and Gantry Cranes," and of CMAA-70, "Specifications for Electric Overhead Traveling Cranes."[9] An alternative to a specification in ANSI B30.2 or CMAA-70 may be accepted in lieu of specific compliance if the intent of the specification is satisfied.

2.3.7.1 Summary of Licensee's Evaluation of Crane Design

All the Licensee's cranes and hoists have been designed in accordance with CMAA Specification 70 and ANSI B30.2, Chapter 2-1.

2.3.7.2 EG&G Evaluation, Conclusions and Recommendations on Crane Design

It appears to EG&G that the Licensee has all its cranes designed in accordance with CMAA-70 or ANSI B30.2. Documentation that indicates criteria cranes were procured and delivered should be available for possible NRC review.

2.3.7.3 Summary on Crane Design

The Virgil C. Summer Nuclear Plant Unit 1 complies with the criteria of NUREG-0612, Guideline 7, on crane design.

3. CONCLUDING SUMMARY

3.1 Applicable Load Handling Systems

The list of cranes and hoists supplied by the Licensee as being subject to the provisions of NUREG-0612 is complete (see Section 2.2). In Section 2.2.1.2, the Licensee fulfilled the requirements of NUREG-0612 concerning exclusion of various overhead handling systems.

3.2 Guideline Recommendations

Compliance with four of the NRC guidelines for heavy load handling (Section 2.3) are satisfied at the Virgil C. Summer Nuclear Station Unit 1; i.e., Safe Load Paths, Load Handling Procedures, Crane Operator Training, and Crane Design. The conclusions are presented in tabular form on Table 3.1. Specific recommendations to aid in compliance with the intent of the Special Lifting Devices, Slings, and Crane (Inspection, Test, and Maintenance) guidelines are presented in Table 3.2.

3.3 Interim Protection

If compliance with the seven guidelines of NUREG-0612, Section 5.1, cannot be ensured before the plant operation date, interim protection must be implemented. The six measures defined in NUREG-0612, Article 5.3, must be completed prior to power operation and refueling.

TABLE 3.1 VIRGIL C. SUMMER NUCLEAR STATION UNIT 1 COMPLIANCE MATRIX

Equipment Designation	Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane-Test and Inspection	Guideline 7 Crane Design
Reactor Cavity Manipulator Crane - XCR-1	C	2	C	C	C	NC	NC	C	C
Spent Fuel Pit Bridge Crane - XCR-2	C	2	C	C	C	NC	NC	C	C
Spent Fuel Pit Bridge Crane Protex Cable Reel - XCR-16	C	--	C	C	C	NC	NC	C	C
Fuel Handling Building Crane - XCR-3	C	125/25	C	C	C	NC	NC	C	C
New Fuel Elevator Winch - XCR-45	C	--	C	C	C	--	NC	C	C
Fuel Transfer Canal Gate Hoist - XCR-49	C	3	C	C	C	--	NC	C	C
Reactor Buidling Polar Crane - XCR-4	C	360/25	C	C	C	NC	NC	C	C
Turbine Buidling Crane - XCR-16	C	220/30	C	C	C	C	NC	C	C
Auxiliary Building Elevation 463 Hoist - XCR-18	C	10	C	C	C	C	NC	C	C
Auxiliary Building elevation 485 Hoist - XCR-19	C	7.5	C	C	C	C	NC	C	C
Residual Heat Removal Pumps Hoist - XCR-20A	C								C
Residual Heat Removal Pumps Hoist - XCR-20B	C	5	C	C	C	C	NC	C	C

TABLE 3.1 Continued

Equipment Designation	Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane-Test and Inspection	Guideline 7 Crane Design
Reactor Building Spray Pumps Hoist - XCR-21A	C	5	C	C	C	C	NC	C	C
Reactor Building Spray Pumps Hoist - XCR-21B									C
Auxiliary Building Elevation 412 Hoist - XCR-23A	C	2	C	C	C	C	NC	C	C
Auxiliary Building Elevation 412 Hoist - XCR-23B									
Main Condenser Water Boxes Hoist - XCR-25B									
Main Condenser Water Boxes Hoist - XCR-25C									
Main Condenser Water Boxes Hoist - XCR-25D									
Feedwater Booster Pumps Hoist - XCR-26	C	4	C	C	C	C	NC	C	C
Intermediate Building Elevation 436 Hoist - XCR-27	C	5	C	C	C	C	NC	C	C
Water Treatment Building Elevation 463 Hoist - XCR-28	X	2	C	C	C	C	NC	C	C

TABLE 3.1 Continued

Equipment Designation	Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane-Test and Inspection	Guideline 7 Crane Design
Emergency Diesel Generator Hoists - XCR-29A	C	2	C	C	C	C	NC	C	C
Emergency Diesel Generator Hoists - XCR-29B									
Intermediate Building Elevation Hoist - XCR-31	C	1/2	C	C	C	C	NC	C	C
Emergency Feedwater Pump Hoist - XCR-33	C	2	C	C	C	C	NC	C	C
Reactor Building Tendon Access Galley Hoist - XCR-34	C	1	C	C	C	C	NC	C	C
Drumming Station Hoist - XCR-36	C	20	C	C	C	C	NC	C	C
Intermediate Building Elevation 436 Hoists - XCR-40A	C	10	C	C	C	C	NC	C	C
Intermediate Building Elevation 436 Hoists - XCR-40B									
Intermediate Building Elevation 436 Hoists - XCR-40C									
Hot Machine Shop Crane - XCR-42	C	10	C	C	C	C	NC	C	C
Service Building Crane - XCR-43	C	10	C	C	C	C	NC	C	C
Auxiliary Building Elevation 463 Crane - XCR-46	C	3	C	C	C	NC	NC	C	C

TABLE 3.1 Continued

Equipment Designation	Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane Test and Inspection	Guideline 7 Crane Design
Drumming Station Crane - XCR-47	C	10	C	C	C	C	NC	C	C
Instrument and Service Air Compressors Hoist - XCR-48	C	1-1/2	C	C	C	C	NC	C	C
Traveling Screens Hoist - XCR-50	C	10	C	C	C	C	NC	C	C
Service Water Pumps Crane - XCR-51	C	10	C	C	C	C	NC	C	C
CRDM Cable Support Structures Hoist - XCR-53A	C	2	C	C	C	C	NC	C	C
CRDM Cable Support Structures Hoist - XCR-53B									
CRDM Cable Support Structures Hoist - XCR-53C									
Safety Injection Charging Pumps Hoists - XCR-54A	C	5	C	C	C	C	NC	C	C
Safety Injection Charging Pumps Hoists - XCR-54B									
Safety Injection Charging Pumps Hoists - XCR-54C									
Drumming Station Jib Crane - XRW-11	C	1	C	C	C	C	NC	C	C
Drumming Station Jib Crane - XRW-13	C	3	C	C	C	C	NC	C	C

TABLE 3.1 Continued

Equipment Designation	Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane-Test and Inspection	Guideline 7 Crane Design
Reactor Building Access Hatch	C	--	C	C	C	C	NC	C	C

C = Licensee action complies with NUREG-0612 Guideline.
NC = Licensee action does not comply with NUREG-0612 Guideline.

TABLE 3.2 SUMMARY OF RECOMMENDATIONS FOR
VIRGIL C. SUMMER NUCLEAR STATION UNIT 1

Guideline	Recommendation
1. Section 2.3.1 - Safe Load Paths	Complete preparation of procedures prior to fuel load and retain for possible NRC audit.
2. Section 2.3.2 - Load Handling Procedures	Complete development of procedures prior to fuel load and retain for possible NRC audit.
3. Section 2.3.3 - Crane Operator Training	Crane operator training information demonstrating compliance with ANSI B30.2-1976 should be available for NRC review.
4. Section 2.3.4 - Special Lifting Devices	Submit the following information on special lifting devices to meet the requirements of ANSI N14.6-1978 as appended by NUREG-0612 Section 5.1.1(4) concerning dynamic effects. (a) Design analysis using stress design factors for dynamic and static loads showing that these devices meet ANSI N14.6. (b) Analysis for those devices that are considered for critical loads. (c) Retrieve and examine fabrication records of special lifting devices for ANSI N14.6 compliance. (d) Examine acceptance testing of special handling devices per ANSI N14.6. (e) Load testing of special lifting devices per ANSI N14.6.
5. Section 2.3.5 - Slings	Submit verification that all slings used on heavy loads comply with ANSI 30.9-1971 as amended by NUREG-0612 Section 5.1.1(5) concerning dynamic effects and sling marking prior to fuel load.
6. Section 2.3.6 - Cranes (Inspection, Testing and Maintenance)	Documentation for cranes inspection, testing and maintenance should be available for possible NRC review.
7. Section 2.3.7 - Crane Design	Documentation that indicates specification that cranes/hoists were procured and delivered to plant should be available for possible NRC review.

4. REFERENCES

1. U.S. Nuclear Regulatory Commission, Regulatory Guide, NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants".

2. V. Stello, Jr. (NRC), Letter to all Licensees, Subject: Request for Additional Information on Control of Heavy Loads Near Spent Fuel, dated May 17, 1978.

3. U.S. Nuclear Regulatory Commission, Letter to South Carolina Electric & Gas Company, Subject: NRC Request for Additional Information on Control of Heavy Loads Near Spent Fuel, dated December 22, 1980.

4. T. C. Nichols, Jr., South Carolina Electric & Gas Company, Letter to H. R. Denton (NRC), Subject: Response to Staff Position, Interim Actions for Control of Heavy Loads, dated June 26, 1981.

5. Gilbert Associates, Inc., GAI Report No. 2289, "Control of Heavy Loads at Nuclear Power Plants - Virgil C. Summer Nuclear Station Unit 1".

6. American National Standards Institute, ANSI B30.2-1976, "Overhead and Gantry Cranes".

7. American National Standards Institute, ANSI N14.6-1978, "Standard for Lifting Devices for Shipping Containers Weighing 10,000 Pounds (00 kg) or More for Nuclear Materials".

8. American National Standards Institute, ANSI B30.9-1971, "Slings".

9. Crane Manufacturers Association of America, Inc., CMAA-70, "Specifications for Electric Overhead Traveling Cranes".