8/31/79
Rutg

Task A-36 Status
Control of Heavy Loads
August 27, 1979

1. Introduction

2. Potential Consequences of Accidental Load Drop

3. Licensee Survey

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4. Historical Data

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TABLE 1
SURVEY OF HEAVY LOADS

AREA	LOADS HANDLING	OVER (O) OR ONLY PROXIMITY TO SPENT FUEL	APPROX. WEIGHT (tons)[1]	FREQUENCY HANDLED
1. PWR - Refueling Building	1. Spent Fuel Shipping Cask	(P)	15-110 Tons	[2]
	2. Pool Divider Gates (some plants)	(P)	2 Tons	2-4 x's (per refueling)
	3. Fuel Transfer Canal Door	(P)	2 Tons	2-4 x's (per refueling)
	4. Missile Shields	(P)	4-20 Tons	2 x's (per refueling)
	5. Irradiated Specimen Shipping Cask	(P)	3.5-12 Tons	Once per year to once per 10 years
	6. Plant Equipment (some plants)	(O)	2-4 Tons	As required for modification or replacement
	7. Spent resin, filter, or other radioactive material shipping casks	(P)	5-10 Tons	~ 5 x's per year
	8. New fuel shipping containers with fuel (usually 4 assemblies)	(P)	3 Tons	[3]
	9. Failed Fuel Container	(O)	1 Ton	Less than once per refueling
	10. Fuel transfer carriage	(O) or (P)	1.5 Tons	Only for maintenance or repair (~once per 10 year
	11. Crane Load Block	(O)	4-10 Tons	[5]
2. PWR - Containment Building	1. Reactor Vessel Head	(O)	55-165 Tons	2 x's (per refueling)
	2. Upper Internals	(O)	25-65 Tons	2 x's (per refueling)
	3. In-Service Inspection Tool	(O)	4.5 Tons	Used at least once every three years

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AREAS	LOADS HANDLING	OVER (O) OR ONLY PROXIMITY TO SPENT FUEL	APPROX. WEIGHT (Tons) 1/	FREQUENCY HANDLED
2. (cont.)	4. Reactor Coolant Pump	(P)	30-40 Tons	4-10 times over life of plant
	5. Missile Shields	(P)	10-20 Tons	2 x's (per refueling)
	6. Crane Load Block	(O)	4-10 Tons	5/
3. BWR - Reactor Building	1. Missile or Shield Plugs (6-12)	(P)	15-125 Tons	2 x's (per refueling)
	2. Drywell Head	(P)	45-85 Tons	2 x's (per refueling)
	3. Reactor Vessel Head	(O) (over reactor)	45-96 Tons	2 x's (per refueling)
	4. Steam Dryers	(O) (over reactor)	20-40 Tons	2 x's (per refueling)
	5. Moisture Separators	(O) (over reactor)	20-75 Tons	2 x's (per refueling)
	6. Spent Fuel Pool Gates	(O) (over spent fuel pool)	2-6 Tons	2 x's (per refueling)
	7. Dryer/Separator Storage Pit Shield Plugs (some plants)	(P)	75 Tons	2 x's (per refueling)
	8. Refueling Slot Plugs	(O) (over spent fuel pool)		
	9. Spent Fuel Shipping Cask	(O) (over spent fuel pool)	15-110 Tons	4/
	10. Vessel Service Platform	(O)	1-5 Tons	5-10 x's (per refueling)

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AREA	LOADS HANDLED	OVER (O) OR ONLY PROXIMITY TO SPENT FUEL	APPROX. WEIGHT (Tons)[1/]	FREQUENCY HANDLED
3.(cont.)	12. Waste and Debris Shipping Casks	(O) (over reactor and/ or spent fuel pool)	8-30 Tons	1-3 x's (per year)
	13. Vessel Head Insulation	(P)	4-6 Tons	2 x's (per refueling)
	14. Replacement Fuel Storage Racks for Spent Fuel	(O) (over spent fuel)	8 Tons	On installation
	15. Crane Load Block	(O)	4-10 Tons	[5/]
4. Other Plant Areas	1. Spent Fuel Shipping Casks (some plants)	(O) (over safety equipment)	15-110 Tons	[4/]
	2. Turbine or other equipment in turbine building (some plants)	(O) (over safety equipment)	2-	For equipment overhaul and replacement

3. Any Friday?

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TABLE 1
FOOTNOTES

1/ Listed weight does not include weight of load block which may add 4-10 tons to the weight of the dropped load.

2/ These are presently not being used at most plants. However, once long term waste repositories are established, casks will be used frequently for shipping spent fuel offiste. For a typical 1,000 MWe pressurized water reactor, spent fuel casks must be shipped offsite from 7 to 65 times per year depending on the size cask currently licensed for use in the United States.

3/ A typical 1,000 MWe power plant would usually require 16 or 17 new fuel containers (four fuel assemblies each) per year.

4/ These are presently not being used at most plants.. However, once long term repositories are established, casks will be used frequently for shipping fuel offsite. For a typical 1,000 MWe boiling water reactor, spent fuel casks must be shipped offsite from 12 to 125 times per year depending on the size cask used. This is based on casks currently licensed for use in the United States.

5/ Since crane load blocks for the larger cranes typically weigh 4-10 Tons. Thus the load blocks should be considered a heavy load even if they are not carrying a load. They may be used many times with lighter loads.

TABLE 7

SUMMARY OF LOAD

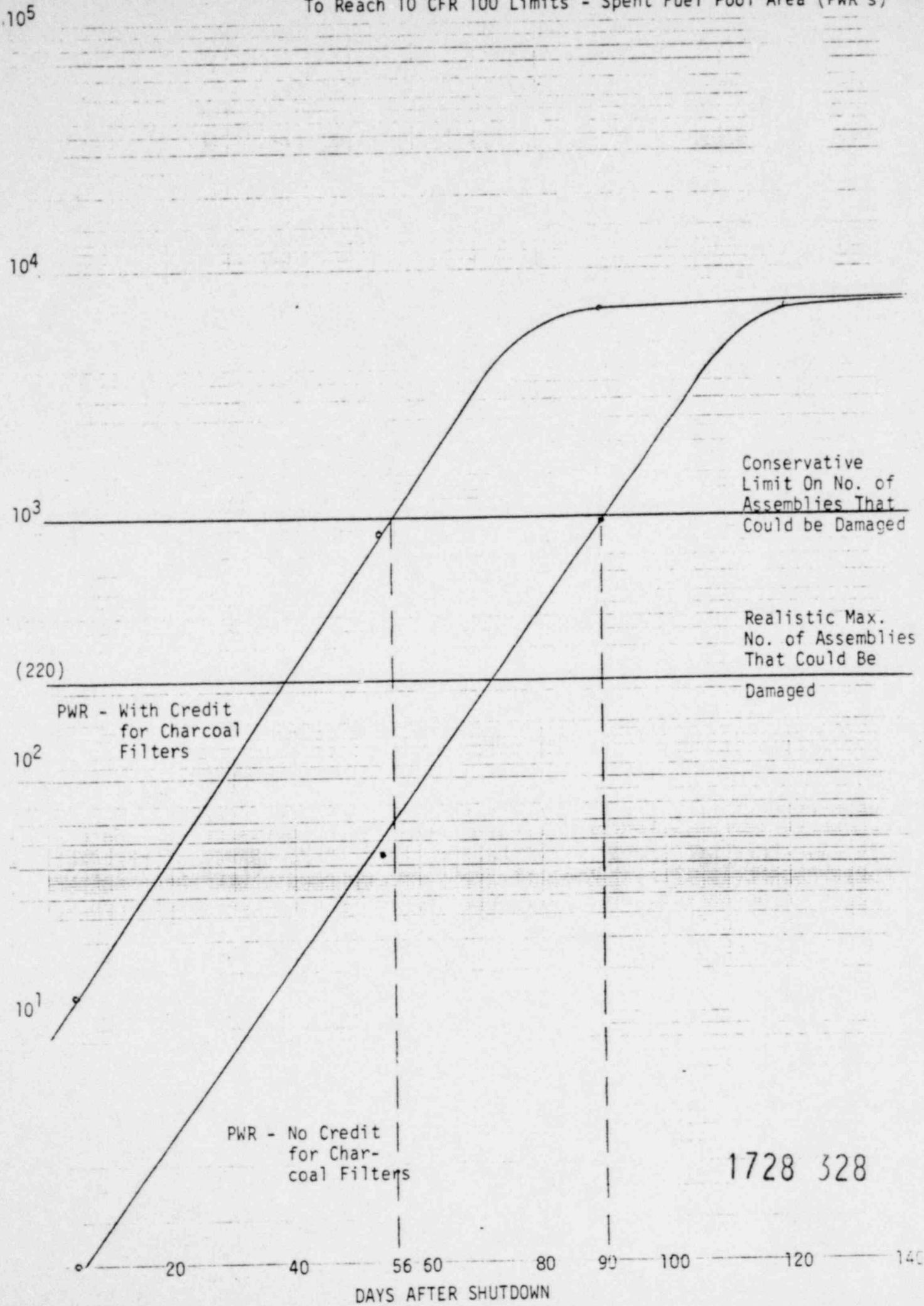
DROP ACCIDENT ANALYSES

	No. of Days Subcritical	Exclusion Radius Dose[1] Thyroid	Exclusion Radius Dose[1] Whole Body	Low Population Zone[1] Thyroid	Low Population Zone[1] Whole Body	Minimum No. of Assy's Reach 1/3 of Part 100 Limits[2]
	4 (no. filters)	172.5	.612	17.26	.061	1 Assy
	4 (w/filters)	8.628	.579	.863	.058	12 Assy's
P	54 (no filters)	2.319	.0025	.2319	.0002	44 Assy's
W	54 (w/filters)	.1143	.0021	.0114	.0002	8.8×10^2 Assy's
R	90 (no filters)	.1046	.00121	.0105	.0001	9.6×10^2 Assy's
	90 (w/filters)	.0052	.00120	.0005	.0001	7.0×10^3 Assy's
	120 (no filters)	.0079	.00118	.0008	.0001	7.1×10^3 Assy's
	120 (w/filters)	.0004	.00118	.0000	.0001	7.1×10^3 Assy's
	1 (no filters - SBGT)	92.260	.701	9.226	.070	1 Assy
B	1 (w/filters-SBGT)	4.613	.653	.461	.065	13 Assy's
W	90 (no filters - SBGT)	.0360	.0004	.0036	.0000	2.8×10^3 Assy's
R	90 (w/filters - SBGT)	.0018	.0004	.0002	.0000	2.1×10^4 Assy's

[1] Dose per fuel assembly damaged (REM's).

[2] Number assemblies that must be damaged to approach (1/3 of) Part 100 exposure limits of 300 REM Thyroid and 25 REM Whole Body.

To Reach 10 CFR 100 Limits - Spent Fuel Pool Area (PWR's)



No. of Assemblies That Must be Damaged to Reach 1/3 of 10 CFR Part 100 Dose Limits

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TABLE 2

CRANES SATISFYING INTENT OF
R.G. 1.104 or NUREG 0554
SINGLE FAILURE PROOF CRANE[1]

		YES		NO	
		# Plants	# of Cranes	# Plants	# of Cranes
PWR:	Containment Polar Crane	0	0	36	36
	Refueling Building Crane	2	2	34[2]	24[2]
BWR:	Reactor Building Crane	13	10	5[3]	5[3]

[1] 4 reactors were covered in the survey. Not included were eleven (11) SEP plants, two (2) plants indefinitely out of service, two (2) plants which were recently licensed, and Ft. St. Vrain which is a Gas-Cooled Reactor (there are 70 plants licensed to operate as of July 1979).

[2] However, licensees of three (3) of these plants have committed to upgrade the cranes used to handle the cask (affects two (2) cranes), although no date for completion of this upgrading has been established.

[3] However, one BWR licensee has committed to upgrade the reactor building crane.

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SEP not included

TABLE 3

SURVEY OF DESIGN FEATURES RELATED TO CONTROL OF HEAVY LOADS [1]

	Plants	
	Yes	No
Containment (Spent Fuel Pool Area)	51	3
Charcoal Filters (Spent Fuel Pool Area)	51	3
Pool Designed for Cask Drop	26	28
Containment Isolation on High Radiation (PWR)	16[2]	20
Compliance with Regulatory Guide 1.13	39	15

[1] Exclusive of crane features covered by Table 2.

[2]
D.C. Cook 1 & 2
Ft. Calhoun
Farley
Maine Yankee
North Anna 1
Point Beach 1 & 2
Prairie Island 1 & 2
Rancho Seco
Salem 1
Turkey Point 3 & 4
Zion 1 & 2

TABLE 4

SURVEY OF LICENSEE

ANALYSES RELATED TO

CONTROL OF HEAVY LOADS

	PLANTS	
	Yes	No
Cask drop damage to fuel	5	49
Fuel handling accident	54	0
Potential for drop to cause criticality	3[1]	51
Plenum assembly or reactor head drop	6	48

[1] These only considered potential for a drop to cause criticality in the spent fuel pool, but not in the reactor.

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TABLE 5

SURVEY OF PROCEDURES IN

EFFECT RELATED TO CONTROL

OF HEAVY LOADS

		Plants	
		Yes[1]	No[2]
1.	Procedures on crane operation	34	21
2.	Refueling Procedures	30	25
3.	Movement of Reactor Components during or prior to refueling	27	28
4.	Cask Handling Operations	22	33
5.	Crane operator training	3	52

[1] In some cases procedures were not submitted, but were referenced by title and/or description.

[2] Information provided by licensees did not indicate that such procedures were in use.

TECHNICAL SPECIFICATIONS

Our Survey to T.S.

1. Plants that do not have a Technical Specification prohibiting handling of heavy loads (i.e., greater than a fuel assembly plus handling tool) or the Cask Over Spent Fuel:

	NOTES
Big Rock Point Browns Ferry 1 - 3 Cooper	Single Failure Proof Crane Limit Switches To Prevent Travel Over Spent Fuel
Dresden 1 Duane Arnold Ft. Calhoun	Electric interlocks To Prevent Travel Over Spent Fuel
LaCrosse H. B. Robinson	Single Failure Proof Crane
FitzPatrick Monticello Nine Mile Point Oyster Creek Palisades Pilgrim Maine Yankee	Single Failure Proof Crane Single Failure Proof Crane

2. Plants That Prohibit Cask, but do not prohibit smaller heavy loads, from being brought over spent fuel:

Dresden 2 and 3 Hatch 1 Haddam Neck Indian Point 2 Millstone 1	Single Failure Proof Crane Single Failure Proof Crane
Quad Cities 1 and 2	Single Failure Proof Crane
Turkey Point 3 and 4	Single Failure Proof Crane
Vermont Yankee	

APPENDIX A-1

CAUSES OF CRANE ACCIDENTS

DEPARTMENT OF THE NAVY

Feb 74 – Oct 77

2500 – 3000 Cranes

CAUSE CATEGORY	NO. OF LOAD DROP OR POTENTIAL LOAD DROP EVENTS	% OF TOTAL	TOTAL NUMBER OF CRANE EVENTS RESULTING IN EQUIPMENT DAMAGE	% OF TOTAL
1. Crane Failure	10	23%	17	23%
(Design Error)	(1)	(2.3%)	(2)	(3%)
(Maintenance Personnel)	(2)	(4.6%)	(2)	(3%)
(Crane Component Failure)	(7)	(16.3%)	(13)	(17%)
2. Crane Operator Error	30 1/	70%	54	73%
(Distraction/ Inattention)	(11)	(26%)	(24)	(32%)
(Inadequate Training)	(8)	(18%)	(13)	(19%)
(Failed To Follow Proper Precautions/ Procedures)	(11)	(26%)	(17)	(23%)
3. Rigging	3	7%	3	4%
(Rigger)	(3)	(7%)	(3)	(4%)
(Rigging)	(0)	(0)	(0)	(0)

1/ 15 (50%) of these events occurred when the crane or hoist was left in the "raise" mode or inadvertently raised to limit.

Data Good

Jan – Oct 77

.02 load drops / Crane year

31 / 1800 Crane years

Navy Cranes – Very Active

Many lifts per year

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APPENDIX A-2

DATA ON CRANE ACCIDENTS

FROM OSHA[1] RECORDS

The following is a statistical summary of major crane accident causes based on an analysis of over 1,000 crane accidents involving damage to equipment:

	CAUSE CATEGORY	PERCENTAGE
A.	Loss of load due to poor rigging or slings	34%
B.	Performing minor maintenance, inspection, or unrelated work while load is in motion	22%
C.	Operating crane without authorization or proper signals	18%
D.	Failure of defective boom, cable, or sheaves	14%
E.	Failure due to overloading	4%
F.	Handling load too near stationary equipment	2%
G.	Other causes (including failures of control systems and inadequate inspection or maintenance)	6%

[1]Occupational Safety and Health Administration

TABLE 8

SURVEY OF CRANE

LER EVENTS

Very Different from Navy Data

Cause Category	No. of Events
A. Failure during plant construction phase	2
B. Failure due to design or fabrication errors	9
C. Failure due to lack of adequate inspection	2
D. Failure due to operator error or lack of training	8
E. Failure due to random mechanical component failures	5
F. Failure due to random failures of control system components	3
G. Events due to lack of operating procedures	4
H. Events due to crane overloading (including load hangup)	1

4.1 Guidelines for Control of Heavy Loads

The following sections describe various alternative approaches which provide acceptable measures for the control of heavy loads. The objectives of these guidelines are to assure that for each areas addressed, ~~the following criteria are satisfied~~:

(1) Releases of radioactive material that may result from damage to spent fuel due to accidental dropping of a heavy load ~~are~~ less than or of the order of 300 REM Thyroid, 25 REM Whole B. significantly less than 10 CFR Part 100 limits;

(2) Damage to fuel and fuel storage racks due to accidental dropping of a heavy load will not result in such a configuration of the fuel that k_{eff} approaches or is larger than 1;

(3) Damage to the reactor vessel or the spent fuel pool due to accidental dropping of a heavy load will not result in leakage that could uncover the fuel, (makeup provided to overcome leakage should be from a borated source of adequate concentration if the water that is being lost is borated) ~~and~~; and

(4) Accidental load drops will not damage equipment required for safe shutdown or continued decay heat removal such that this equipment cannot perform its intended function.

After reviewing the historical data available on crane operations and identifying the principal causes of load drops, and considering the type and frequency of load handling operations at nuclear power plants, the task group has developed an overall philosophy that provides a defense-in-depth approach to controlling the handling of heavy loads. This philosophy encompasses an intent to prevent as well as mitigate

the consequences of postulated accidental load drops. The following summarizes this defense-in-depth approach:

(1) Provide sufficient operator training, handling system design, load handling instructions, and equipment inspection to assure reliable operation of the handling system;

(2) Define safe load paths through procedures and operator training so that heavy loads are not carried over or near spent fuel or safe shutdown equipment; and

(3) Provide electrical interlocks to prevent movement of heavy loads over spent fuel or in proximity to equipment associated with redundant shutdown paths.

Certain alternative measures may be taken to compensate for deficiencies in (2) and (3) above, such as the inability to prevent a particular heavy load from being brought over spent fuel (e.g., reactor vessel head). These alternative measures can include: increasing crane reliability by providing redundancy (dual) or de... in certain components, increased safety factors, and increased inspection as discussed in Section 4.1.6 of this report; or prohibiting crane operations in the spent fuel pool area (PWRs) until fuel has decayed so that off-site releases would be sufficiently low if fuel were damaged. Even if one of these alternative measures is selected, (1) above should still be satisfied, as well as defining safe load paths, to provide adequate defense-in-depth.

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The following sections provide guidelines on how the above defense-in-depth approach may be satisfied for various plant areas. Fault trees were developed and used to evaluate the adequacy of these guidelines and to assure a consistent level of protection for the various areas.

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4.1.1 General

All plants have overhead handling systems that are used to handle heavy loads, in the area of spent fuel in the reactor vessel or in the spent fuel pool. Additionally, loads may ~~also~~ be handled in areas where their accidental drop may damage safe shutdown systems. Accordingly, all plants should satisfy the following for handling heavy loads in the spent fuel pool area, in containment (PWRs), in the reactor building (BWRs), and in other plant areas where heavy loads ~~are~~ may be brought in proximity to or over safe shutdown systems.

(1) Safe load paths should be defined for the movement of heavy loads to provide maximum practical separation of heavy loads from spent fuel in the reactor vessel and in the spent fuel pool, and from safe shutdown equipment. These load paths should be defined in procedures or shown on equipment layout drawings. Deviations from defined load paths should receive prior approval from the shift supervisor or other designated plant management.

(2) Procedures should be developed to cover critical load handling operations, particularly those requiring use of special handling devices, such as: removal and replacement of the drywell head (BWRs); removal and replacement of the reactor vessel head; removal and replacement of upper vessel internals; removal and replacement of the spent fuel pool gate ~~(BWRs)~~; crane operation; and spent fuel cask handling. These procedures should include: identification of required equipment; inspections required before movement of load, including acceptance criteria; critical steps to be followed and proper sequence in handling the load; reference or inclusion of safe load path; and special precautions.

(3) Crane operators are trained and qualified in accordance with chapter 2-3 of ANSI B30.2-1976, "Overhead and Gantry Cranes," prior to their handling of heavy loads.

(4) Special lifting devices should meet the intent of ANSI N14.6-1978, "Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 pounds (4500 kg) or More for Nuclear Materials." 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 the intervening components of the special handling device.

(5) Lifting devices that are not specially designed should be installed and used in accordance with the guidelines of ANSI B30.9-1971, "Slings".

(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 yearly, or every 18 months, during refueling operations, and is generally not accessible during power operation. ANSI B30.2, however, calls for certain inspections to be performed daily or ~~annually~~ monthly. For a polar crane these inspections should be performed prior to refueling operations).

(7) The crane should be designed to meet the applicable criteria of CMAA-70, "Specifications for Electric Overhead Cranes." Alternatives to a specification in CMAA-70 may be accepted in lieu of specific compliance if the intent of the specification is satisfied.

4.1.2 SPENT FUEL POOL AREA - PWR

Most PWR's require that the spent fuel shipping cask be placed in the spent fuel pool for loading. Additionally, other heavy loads may be carried over or near the spent fuel pool, including plant equipment, rad-waste shipping casks, damaged fuel ~~cask~~, and the crane load block. To provide assurance that the ~~criteria~~ of Section 4.1 are met for load handling operations in the spent fuel pool area, one of the following should be satisfied:

(1) The crane and associated lifting devices used for handling heavy loads in the spent fuel pool area should satisfy the guidelines of Section 4.1.6 of this report.

OR

(2) Each of the following are provided: ~~(this alternative is intended for plants that do not require placement of the cask in the spent fuel pool for loading)~~:

(a) Electrical interlocks should be provided that prevent movement of the crane load block over or within (~~10~~ 15 feet) (horizontal) of the spent fuel pool. These electrical interlocks may not be bypassed when the pool contains "hot" spent fuel.

(~~b~~)(c) To preclude rolling if dropped, the cask should be carried at no more than six (6) inches above the floor of the spent fuel pool area.

OR

(3) Each of the following are provided:

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(a) "Hot" spent fuel should be concentrated in one location in the spent fuel pool that is separated as much as possible from load paths.

(b) Electrical interlocks should be provided to prevent movement of the crane load block over or within (25 feet) (horizontal) of the "hot" spent fuel. As much as possible loads should still be moved over load paths that avoid the spent fuel pool and not brought even as close as (25 feet) to the "hot" spent fuel unless necessary. Interlocks should not be bypassed as long as the pool contains "hot" spent fuel. These electrical interlocks should not be bypassed without approval from the shift supervisor (or other designated plant management individual). Interlocks should be verified to be operational prior to placing "hot" spent fuel in the pool.

(c) ~~[illegible]~~

(d) To preclude rolling, if dropped, the cask should be carried at no more than six (6) inches above the floor of the spent fuel pool area.

(e) ~~(d)~~ Load drops into the pool ~~where movement is allowed by electrical interlocks,~~ should be analyzed and shown not to cause leakage that could uncover the fuel.

OR

(4) Each of the following are provided:

(a) Movement of the crane load block is prohibited if the spent fuel pool contains "hot" spent fuel. Power to the crane is removed during this period.

(b) Load drops of heavy loads, including the crane load block, into the pool should be analyzed and shown not to cause leakage that could uncover the fuel.

(c) To preclude rolling, if dropped, the cask should be carried at no more than six (6) inches above the floor of the spent fuel pool area.

(d) (Section 4.1.2(3)(c)-)

OR

(5) The effects of drops of critical loads should be analyzed and shown to satisfy the ~~criteria~~ of Section 4.1 of this report. Such analyses should consider the following:

i. That the load is dropped in an orientation that causes the most severe consequences;

ii. That fuel impacted is 100 hours subcritical (or whatever the minimum that is allowed in facility technical specifications prior to fuel handling);

iii. That the load may be dropped at any location in the crane travel area where movement is not restricted by electrical interlocks;

iv. That credit may not be taken for spent fuel pool area filters if hatches, wall, or roof sections are removed for handling of the heavy load being analyzed, ~~or~~ or whenever the building negative pressure rises above (-)1/8 inch water gauge to prevent exfiltration from the spent fuel storage building.

POOR ORIGINAL

4.1.3 CONTAINMENT BUILDING - PWR

A PWR containment buildings contain a polar crane that is used for removing and reinstalling shield plugs, the reactor vessel head, upper internals, and reactor coolant pump ~~(if required)~~. Other heavy loads that the polar crane may be required to handle are the reactor vessel inspection platform and the damaged fuel cask. To provide assurance that the criteria of Section 4.1 are met for load handling operations in the containment building, one of the following should be satisfied:

(1) The crane and associated lifting devices used for handling heavy loads in the containment building should satisfy the guidelines of Section 4.1.6 of this report.

OR

(2) The effects of drops of heavy loads should be analyzed and shown to satisfy the ~~criteria~~ of Section 4.1. Loads analyzed should include the following: reactor vessel head; upper vessel internals; vessel inspection platform; damaged fuel cask; irradiated sample cask; reactor coolant pump (unless safe load paths are defined and electrical interlocks are provided to prevent movement of the load block over or near the reactor vessel when handling a reactor coolant pump ~~or~~ other plant equipment); any other heavy loads brought over or near the reactor vessel. Loads need not be analyzed if their effects are scoped by the analysis of some other load. In this analysis, credit may be taken for containment isolation ~~of the purge system~~ if such is provided with prompt automatic actuation on high radiation. Additionally, the analysis should satisfy 4.1.2(5) i-iii.

4.3.4 Reactor Building-BWR

The reactor building in BWRs typically contains the reactor vessel and spent fuel pool, as well as various safety-related equipment.

The reactor building overhead crane may be used in many day-today operations such as moving waste shipment casks or handling plant equipment related to maintenance or modification activities. The crane may also be used during refueling operations for removal and reinstallation of shield plugs, drywell head, reactor vessel head, steam dryers and separators, and refueling canal plugs and gates. The crane would also be used subsequent to refueling for handling of the spent fuel shipping cask. This cask may be lifted as high as feet above the floor elevation at which the cask is brought into the reactor building.

The assure that the criteria of Section 4.1 are satisfied, one of the following should be met:

(1) The reactor building crane, and associated lifting devices used for handling the above heavy loads, should satisfy the criteria of Section 4.1.6 of this report.

OR

(2) The effects of heavy load drops in the reactor building should be analyzed to show that the objectives of Section 4.1 are satisfied. The loads analyzed should include: shield plugs, drywell head, reactor vessel head; steam dryers and separators; refueling canal plugs gates; spent fuel shipping cask; vessel inspection platform; and any other heavy loads that may be brought over or near spent fuel in the reactor vessel or spent fuel pool.

Credit may be taken in this analysis for operation of the Standby Gas Treatment System if facility technical specifications require its

operation during periods when the load being analyzed would be handled.

The analysis should also conform to items 4.1.2 (5)i through iii. Loads whose effects are scoped by the analysis of some other load need not be analyzed.

4.1.5 Other Areas

In other plant areas, loads may be handled which, if dropped in a certain location, may damage safe shutdown equipment. Although this is not a concern at all plants, loads that may damage safe shutdown equipment at some plants include the spent fuel shipping cask, turbine generator parts in the turbine building, and plant equipment such as pumps, motors, valves, heat exchangers, and switchgear. Some of these loads may be smaller than a "heavy load", but may be sufficient to damage safe shutdown equipment.

In addition, the cask may be handled at heights greater than the 30 feet at which the cask is qualified for a load drop, such as in the transporting of the cask from the spent fuel area to the vehicle which will transport the cask offsite. A drop of the cask may result in damage to the cask and release of its contents.

For plant areas other than reactor and containment buildings and spent fuel pool areas, the following should be satisfied for cranes that may carry loads over safe shutdown equipment or that may handle the spent fuel shipping cask:

(1) If the spent fuel cask can be handled at a height of 30 feet or more above the ground (or above a floor), then one of the following should be met:

a. The crane and associated lifting device should conform to the criteria of Section 4.1.6 of this report;

OR

b. The effects of a drop of the cask from its maximum height should be analyzed and show that the releases would be significantly less than 10 CFR Part 100 limits.

(2) If safe shutdown equipment are within the travel path of overhead handling systems (such as carrying the cask over a safety related building or handling of a main turbine rotor over a safety related area in the turbine building) one of the following should be satisfied:

a. The crane and associated lifting device should conform to the criteria of Section 4.1.6 of this report;

OR

b. Safe load paths should be defined so that loads are not carried in proximity to safe shutdown equipment or cabling such that a load drop could impact this equipment. If the load could impact equipment or cabling associated with redundant safe shutdown paths, electrical interlocks should be provided to prevent movement of loads in proximity to these redundant safe shutdown equipment.

OR

c. The effects of load drops have been analyzed and are such that damage to safe shutdown equipment would not preclude operation of the equipment to perform its intended function.

4.1.6 Single Failure Proof Handling Systems

For certain areas, to meet the guidelines of Sections 4.1.2, 4.1.3 4.1.4, or 4.1.5, the alternative of upgrading the crane and lifting devices may be chosen. The purpose of the upgrading is to improve the reliability of the handling system through increased safety factors and redundancy in certain active components. NUREG - 0554, "Single Failure Proof Cranes For Nuclear Power Plants" provides guidance for design, fabrication, installation, and testing of new cranes that are of a high reliability design. For operating plants, Appendix C to this report provides guidelines on implementation of NUREG - 0554 for operating plants and plants under construction in lieu of satisfying all criteria of NUREG - 0554.

There are no staff guidelines issued on design or use of special handling devices or slings. Section 4.1.1 of this report provides certain guidance on special handling devices and slings. Where the alternative of upgrading the sling is chosen, then steps beyond section 4.1.1 should be taken.

Therefore, The following guidelines should be met where the alternative ~~to~~ of upgrading handling system reliability is chosen:

(1) Lifting Devices:

(a) Special Lifting Devices that are used for heavy loads in the area where the crane is to be upgraded should meet ANSI N14.6 1978, "Standard For Special Lifting Devices for Shipping Containers Weighting 10,000 pounds (4500 kg) or More For Nuclear Materials" as specified in Section 4.1.4(4) of this report except that the load is defined as a "critical" load.

(b) Lifting Devices that are not specially designed and that are used for heavy loads in the area where the crane is to be upgraded should meet ANSI B30.9 - 1971, "Slings" as specified in Section 4.1.4(5) of this report except that one of the following should also be satisfied:

(i) Provide redundant slings such that a single component failure or malfunction in the sling will not result in uncontrolled lowering of the load;

OR

(ii) Load-bearing members of the sling should be provided with stress design factors that are twice what is called for in meeting 4.1.4(5) of this report.

2. New Cranes should be designed to meet NUREG - 0554, "Single Failure Proof Cranes For Nuclear Power Plants." For operating plants or plants under construction, the crane should be upgraded in accordance with the implementation guidelines of Appendix C of this report.

3. Interfacing lift points such as lifting lugs or cask trunions should also meet one of the following:

(a) Provide redundancy such that a single lift point failure will not result in uncontrolled lowering of the load; lift points should have a stress design factor of five (5) times the maximum combined static and dynamic load.

OR

(b) Lift points have a stress design factor of ten (10) times the maximum combined static and dynamic load.