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QUADREX

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SUMMARY REPORT
REVIEW OF CRANE DESIGN AND THEIR LOAD PATHS FOR RANCHO SECO NUCLEAR STATION UNIT 1

Prepared for:

SACRAMENTO MUNICIPAL UTILITY DISTRICT
Sacramento, California

Prepared by:

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1700 Dell Avenue
Campbell, California 95008

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1.0 INTRODUCTION

This report, prepared by Quadrex Corporation for Sacramento Municipal Utility District (SMUD), summarizes the results of the review of the overhead load handling systems at SMUD's Rancho Seco Nuclear Generating Station. This review was performed to assist SMUD in preparing their six-month report in respone to USNRC's letter of December 22, 1981 (reference 1).

One Quadrex engineer surveyed the Rancho Seco Plant and interviewed the plant personnel to prepare a list of overhead handling systems and associated lifting devices, to locate the load paths and to identify the safety-related components. Other Quadrex engineers reviewed the design of cranes and lifting devices to evaluate their adequacy per NUREG-0612. Results of this survey and review have been summarized in section 2.0 of this report.

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2.0 REVIEW SUMMARY

Review results for the overhead handling system are presented in the following subsections. The order in which the e have been arranged is identical to that shown in section 2.1 of enc sure 3 to reference 1.

2.1 List of Overhead Handling Systems

The overhead handling systems from which a heavy load drop may result in damage to safety-related components required for plant shutdown or decay heat removal are listed below:

- o Polar Crane in the Reactor Building,
- o Jib Crane in the Reactor Building,
- o Stop Log Hoist in the Spent Fuel Building,
- o Gantry Crane in the Turbine Building,
- o Monorail Hoists in the Auxiliary Building, and
- o Auxiliary Bridge Crane in the Reactor Building.

2.2 Exclusion of Overhead Handling Systems

The following cranes are excluded from the above list because these handle only fuel assembly or other loads which, by definition, are not heavy loads (reference 2):

a. Spent Fuel Handling Bridge in Fuel Storage Building,

b. Main Fuel Handling Bridge in Reactor Building,

c. Auxiliary Fuel Handling Bridge in Reactor Building, and

d. Boom Crane in the Reactor Building.

No overhead handling system listed in section 2.1 above has yet been excluded from evaluation on the justification that sufficient physical separation exist from any potential load-impact point and safety-related component. Evaluation necessary for exclusion on this justification is

underway. Monorail hoists in the Auxiliary Building may be excluded on this justification since a floor slab separates the movements of heavy loads from the safety-related components.

The Jib Crane in the Reactor Building can be excluded from the list of cranes in section 2.1, but from different justifications as stated below:

> This crane moves the in-core instrumentation transfer cask. There are no safety-related components in the vicinity of its load path, but, the crane is capable of moving the load over the reactor vessel. However, SMUD is undertaking modification of this crane. This modification will include installation of mechanical and/or electrical devices which would prevent inadvertent movement of the in-core instrumentation transfer cask over the reactor vessel.

The Stop Log Hoist in the spent fuel building can also be excluded, since SMUD is undertaking upgrading this hoist, or if necessary, will replace it to minimize the possibility of heavy load drop over the spent fuel stored in the pool.

The Auxiliary Bridge Crane in the Reactor Building is also excluded since it does not carry any heavy load over the reactor vessel or any safety-related component.

2.3 Identification of Safe Load Paths

Load paths for heavy loads handled by the overhead handling systems listed in section 2.1 (except Jib Crane, Stop Log Hoist, and Auxiliary Bridge Crane, which are excluded) are identified in general arrangement drawings shown in figures 1 through 10 (see also table 1). Locations of safety-related components in the vicinity of these load paths are also identified in these drawings.

2.4 Measures to Ensure Load handling Within Safe Load Paths

Movements of heavy loads handled by the overhead handling systems listed in section 2.1 are governed by approved operating procedures. These

procedures provide guidance for moving loads from one location to the other. Even though load paths for the movement of heavy loads have not been explicitly stated in these operating procedures, the load paths identified in figures 1 through 10 are the safest and, in general, the shortest routes. Due to plant changes, and changes in the operating conditions, in the future, it may be necessary to follow loads paths other than those shown here. Any such movement, however, will be in accordance with the approved operating procedure governing the crane or the load. This practice is consistent with SMUD's general safety rules and practices.

All movements of heavy loads are performed by qualified operators who are supervised by experienced foremen. These personnel have achieved these positions by demonstrating their craft knowledge and ability in performing the required work. Adherence of these experienced personnel to the operating procedures ensures that the movements of heavy loads follow the safest path possible.

2.5 Tabulation of Heavy Loads, Lifting Devices, and Verification that Load Handling Procedures Exist

Heavy loads handled by each crane listed in section 2.1, their weight, and the lifting devices used are listed in table 2. Handling of these heavy loads are governed by written procedures. These procedures, in general, include sections such as Purpose, References, Limitations and Precautions, Special Tools and Equipment, Testing and Acceptance Criteria, Procedures, Checklists, etc., and meet the requirements of section 5.1.1.(2) of NUREG-0612.

In the future, due to plant changes, it may be necessary to use the cranes listed in section 2.1 to handle additional heavy loads not listed in table 2. Handling of any such additional loads, however, will be performed after engineering and safety review and in accordance with approved written procedure.

The Gantry Crane will be used in the future to move spent fuel casks which constitutes a heavy load. The consequences of potential drops of

spent fuel casks were analyzed earlier by Bechtel and submitted to the NRC. However, before the Gantry Crane is actually used to move the spent fuel cask, this analysis will be reviewed.

2.6 Review of Lifting Devices

Lifting devices listed in table 2 were designed according to industry standards which were applicable at the time these were procured and using good engineering practice. Within the time frame allowed, all of these lifting devices could not be reviewed for compliance with the applicable requirements of ANSI N14.6-1978 or ANSI B30.9-1971. Further evaluation is under way. However, these devices are proof-tested before actually used and are periodically load-tested and inspected in accordance with approved written procedures. Thus, even though evaluations of these devices per ANSI N14.6-1976 or ANSI B30.9-1971 are not complete, SMUD considers these to be safe.

These lifting devices used with the Polar Crane were evaluated to determine their adequacy in accordance with the applicable sections of ANSI N14.6-1978 and ANSI B30.9-1971. In this evaluation, a dynamic loading factor of 1.25 was used which is consistent with the previous evaluation reported in amendment 15, appendix 9A of the FSAR. Evaluation results showed that the lifting devices satisfy the ANSI stress criteria except that the evaluation of the Internals Handling Extension is under way. The nominal lifting load for this device is 352 kips, and the test load is 528 kips. The actual load is 237 kips. Thus, even though the capacity per ANSI N14.6-1978 has not yet been determined, since the test load far exceeds the actual load, the device is considered adequate.

It is noted here that the above evaluation was based on stress design factors specified in section 3.2.1.1 of ANSI N14.6-1978: three for checking with the yield stress, and five for checking with ultimate stress. Doubling these factors per section 6 of ANSI N14.6-1978 (i.e., using six times and ten times the static plus dynamic loads for checking with the yield stress and the ultimate stress, respectively), is not considered justified for the following reasons:

a. For conventional structural and stress analysis of tension members, a safety-margin of 1.5 is typically used, which is equivalent to using a stress design factor of 1.5. Unless the uncertainties of the load, the material, and the analyses method are extreme, the use of a very high stress design factor does not increase the real margin of safety. In other words, if the reliability is likely to be close to 100 percent with a stress design factor of 3.0, increasing this factor to six cannot increase the reliability any further.

b. Lifting devices used in Rancho Seco Plant undergo periodic inspection and load test. This reduces the uncertainties significantly and should enable the use of lower stress design factors.

2.7 Crane Inspection, Testing, and Maintenance

Crane inspection, testing, maintenance, and surveillance procedures have been developed on the basis of the requirements of ANSI B30.9-1976, chapter 2-2.

2.8 Review of Cranes

The cranes listed in table 2 were designed in accordance with industry standards which were applicable at the time these were procured. The Polar Crane and the Gantry Crane were designed according to EOCI and AISC specifications and USAS B30.2 standard. The design specifications of these cranes were reviewed for compliance with the applicable guidelines of CMAA specification 70. The review result showed that the cranes satisfy the general guidelines of CMAA specification 70 which are applicable for evaluating the potential for heavy load drop.

2.9 Crane Operator Training

A training program has been developed in accordance with chapter 2.3 of ANSI B30.2-1976. Additionally, an administrative guideline delineating the control of crane operator training has been developed for implementation. This action is considered adequate and meets the intent of section 5.1.1(3) of NUREG-0612 for the training, qualification, and conduct of crane operators.

TABLE 1

LOAD PATHS FOR MOVEMENT OF HEAVY LOADS

Load Path Identification	Figure No.	Safety Related Equipment
A. REACTOR BLDG.		
1. Polar Crane		
a) Plenum Assembly Transfer Path	1	Reactor Vessel
b) Core Support Transfer Path	2	Reactor Vessel
c) Missile Shield Transfer Path	3	Reactor Vessel
d) RPV Closure Head Transfer Path	4	Reactor Vessel
e) Basket Cask Transfer Path	5	None
f) Basket Cask Transfer Path	6	None
g) Reactor Handling Tools Transfer Path	7	Reactor Vessel
B. TURBINE BLDG.		
1. Gantry Crane		
a) New Fuel Handling Transfer Path	8	None
C. AUXILIARY BLDG.		
1. Monorail Hoist Equipment Hatch (Floor Plugs) Moving Path	9 & 10	High Press. Inject. Pumps P238A, P235, Makeup Pump P-234, Decay Heat Removal Coolers E260A, E260B

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TABLE 2

LIST OF CRANES, LOADS AND LIFTING DEVICES

Bldg./Crane	Loads Handled	Wt. (lbs)	Lifting Devices Used
A. REACTOR BLDG.			
1. Polar Crane	Plenum Assembly	110,000 (dry) 96,000 (wet)	i) Head & Internals Handling Fixture (includes Adapter)
			ii) Internals Handling Extension
			iii) Internals Handling Adapter Pendant
			iv) Internals Indexing Fixture
	Basket Cask Core Support Assembly	12,000 225,000 (dry) 197,000 (wet)	Head & Internals Handling Fixtures & Adapter & Internals Indexing Fixture
	Missile Shield	178,000	Slings
	Closure Head	162,400	i) Head & Internals Handling Fixture
	Closure Head Service Structure	34,600 12,000	ii) Internals Handling Extension
			iii) R.V. Head & Service Structure Fixed Pendants Lifting Assembly
			iv) Turnbuckle Pendant Assembly
	Reactor Handling Tools a) Head & Internals Handling Fixture	12,000	
	b) Internals Indexing Fixture	12,000	

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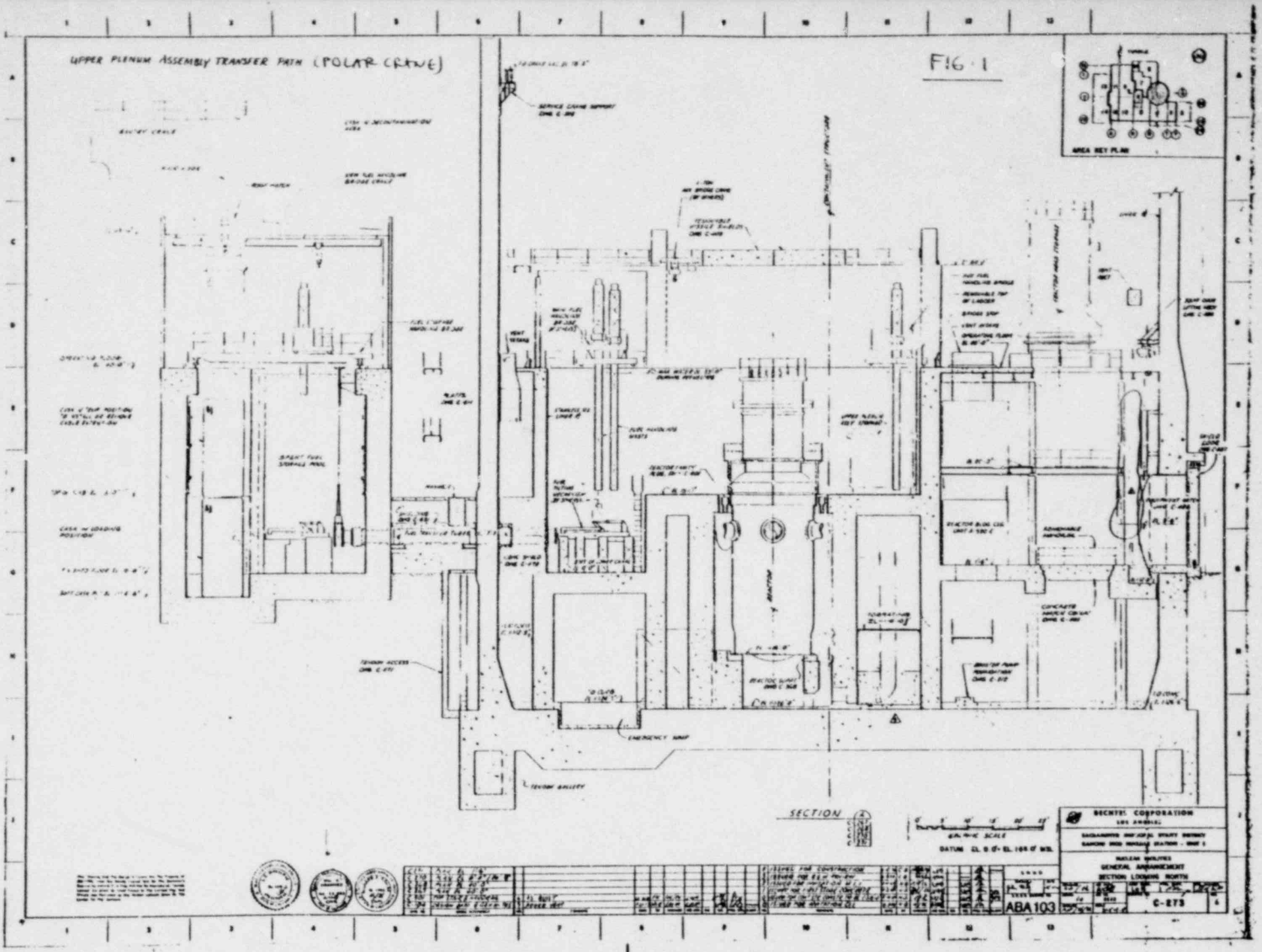
TABLE 2 (Continued)

LIST OF CRANES, LOADS AND LIFTING DEVICES

Bldg./Crane	Loads Handled	Wt. (lbs)	Lifting Devices Used
2. Jib Crane	In-core Instrumentation Transfer Cask	10,300	Slings
3. Auxiliary Bridge Crane	None Identified		Slings
B. SPENT FUEL BLDG.			
1. New Fuel Handling Bridge Crane	Fuel Assembly	1,600	Slings
2. Stop Log Hoist (Tugger)	Stop Logs	3,081	Air Winch & Wirerope
C. TURBINE BLDG.			
1. Gantry Crane	New Fuel Cask Spent Fuel Cask	7,300 136,000	Slings
D. AUXILIARY BLDG.			
1. 10-Ton Monorail Hoist (Item A-1 in Reference #8)	Floor Plugs Heat Exchanger Pump Motors	16,540 5,800 4,925	Slings
2. 10-Ton Hoist (Item A-5 in Reference #8)	Floor Plugs	13,500	Slings



CORE SUPPORT TRANSFER PATH (POLAR CRANE)

SAFETY RELATED EQUIPMENT

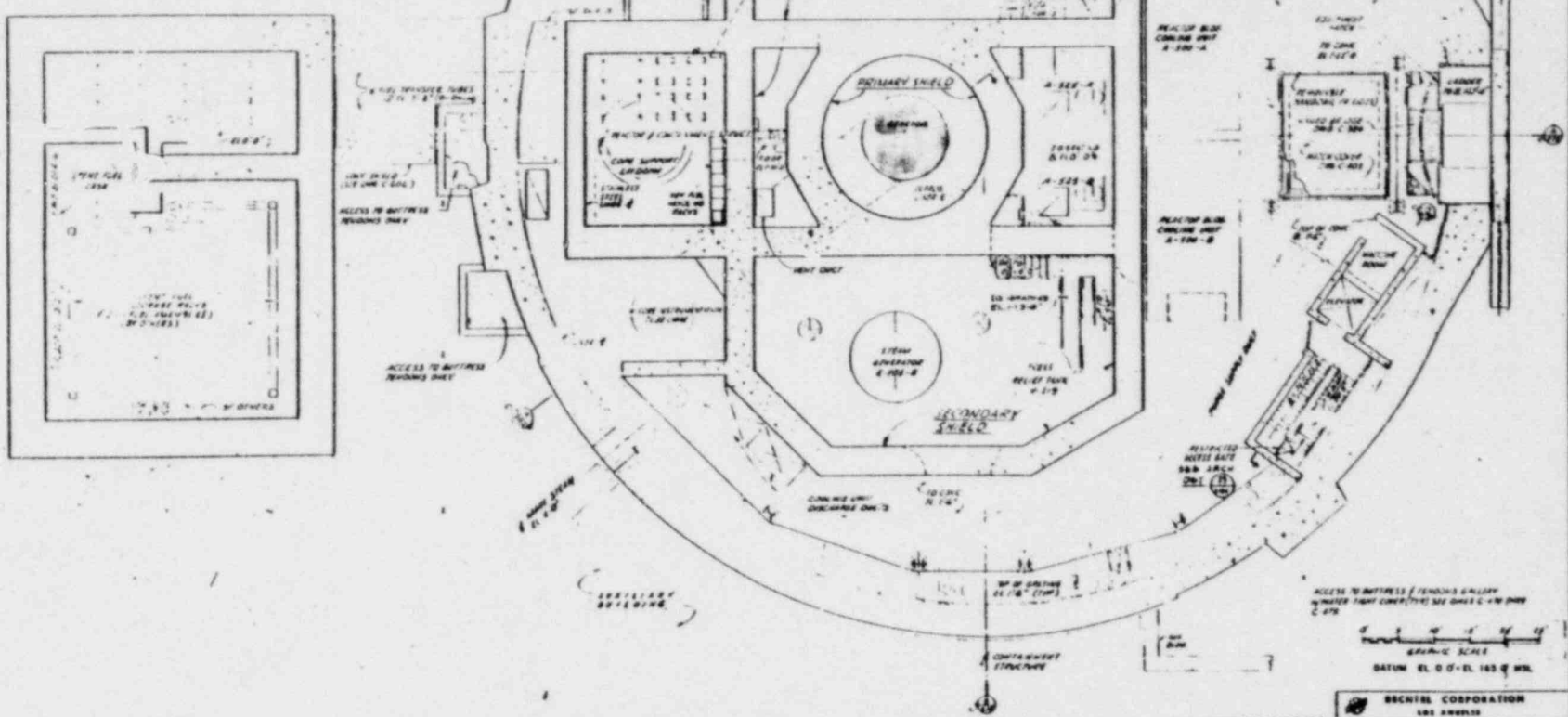


FIG 2

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NUCLEAR FACILITIES
GENERAL ARRANGEMENT
PLAN EL. 1'-6"

ABA 101

C-271

POOR ORIGINAL

FIG 3

MISSILE SHIELDS TRANSFER PATH (POLAR CRANE)

SAFETY RELATED EQUIPMENT

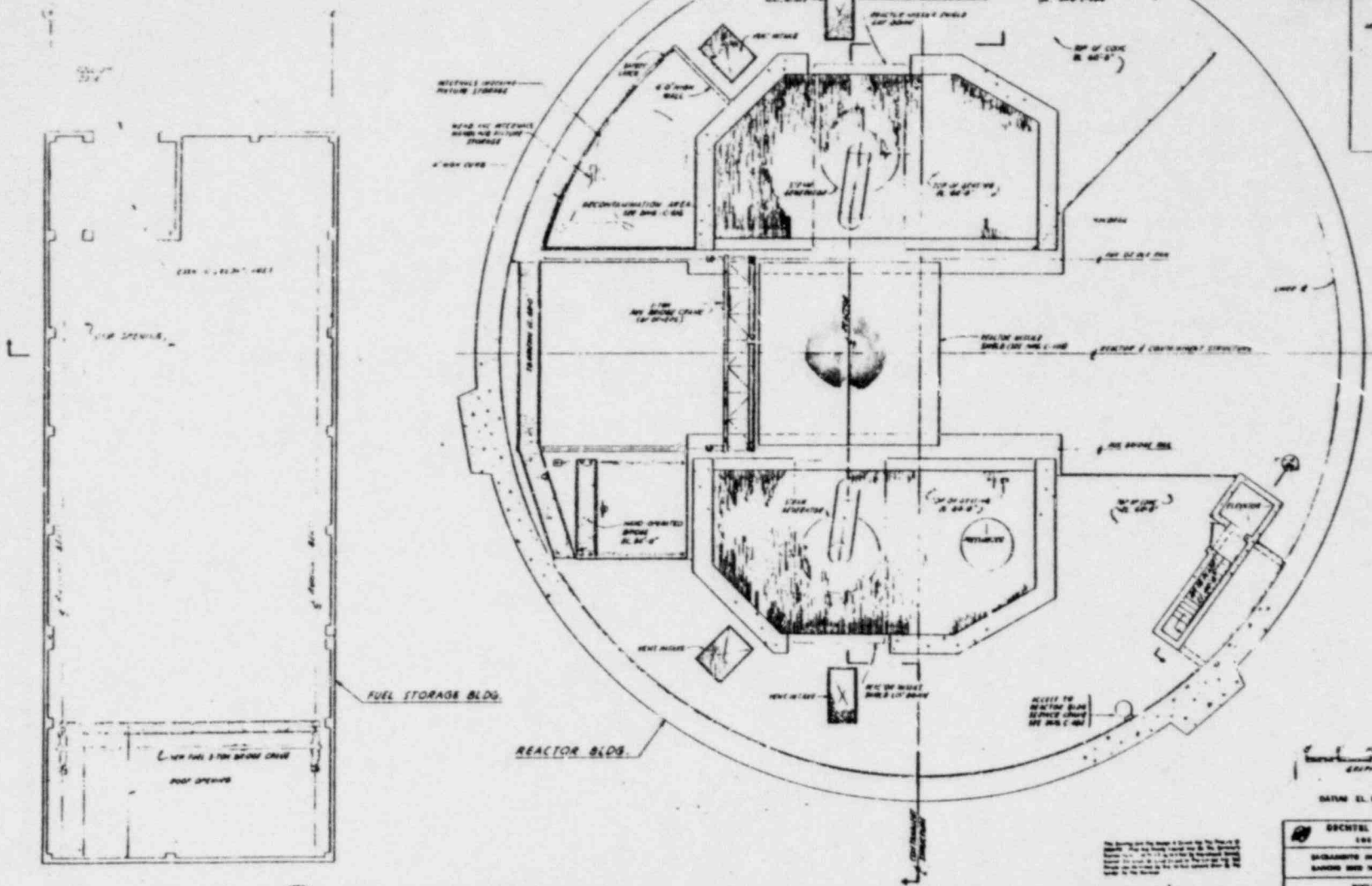
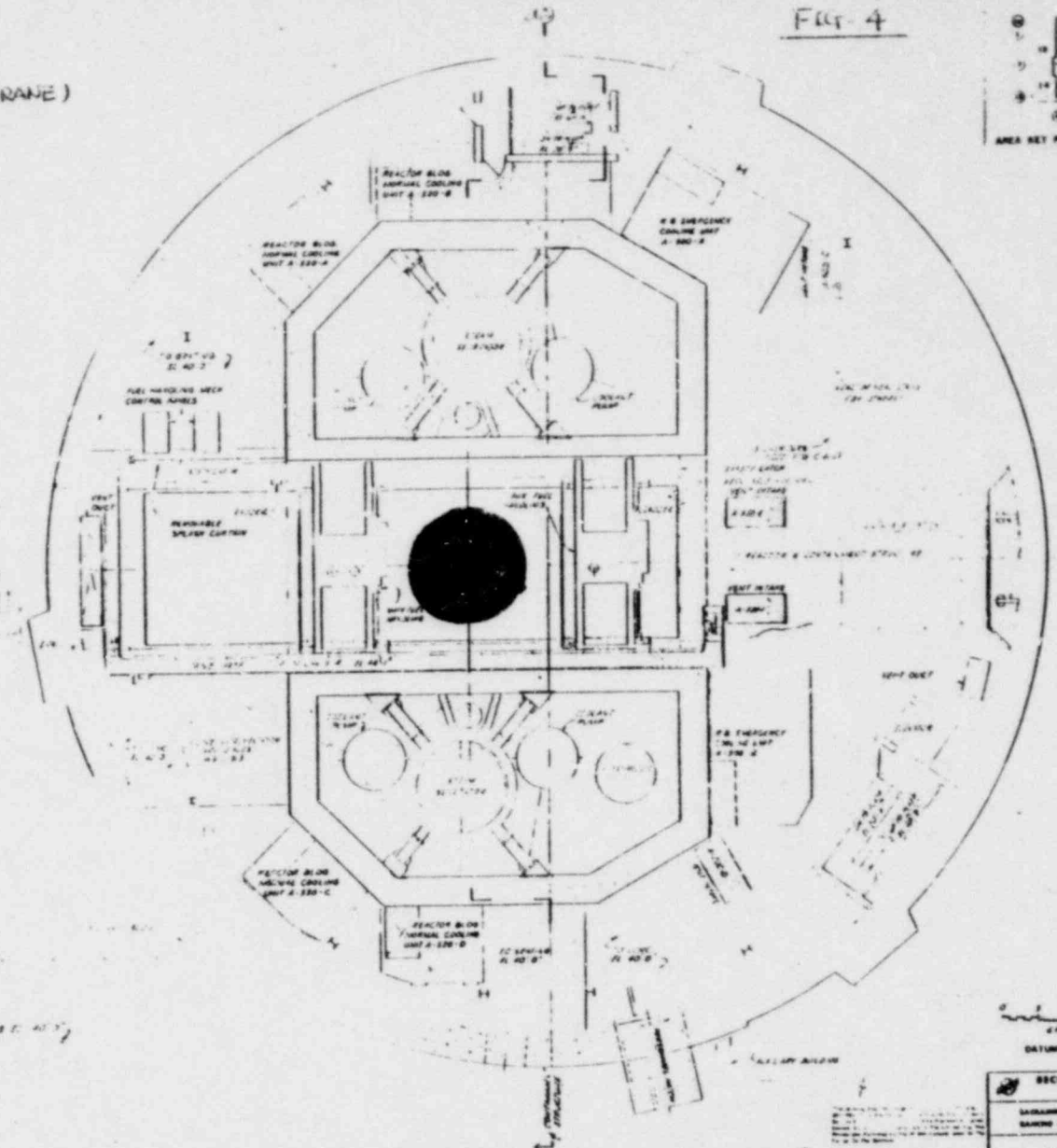
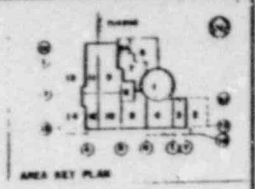


FIG-4

RX VESSEL HEAD TRANSFER PATH (-POLAR CRANE)

SAFETY RELATED EQUIPMENT





DATUM EL 0'-0" = EL 103'-0" MSL

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NUCLEAR FACILITIES
GENERAL ARRANGEMENT
PLAN EL 46'-0"

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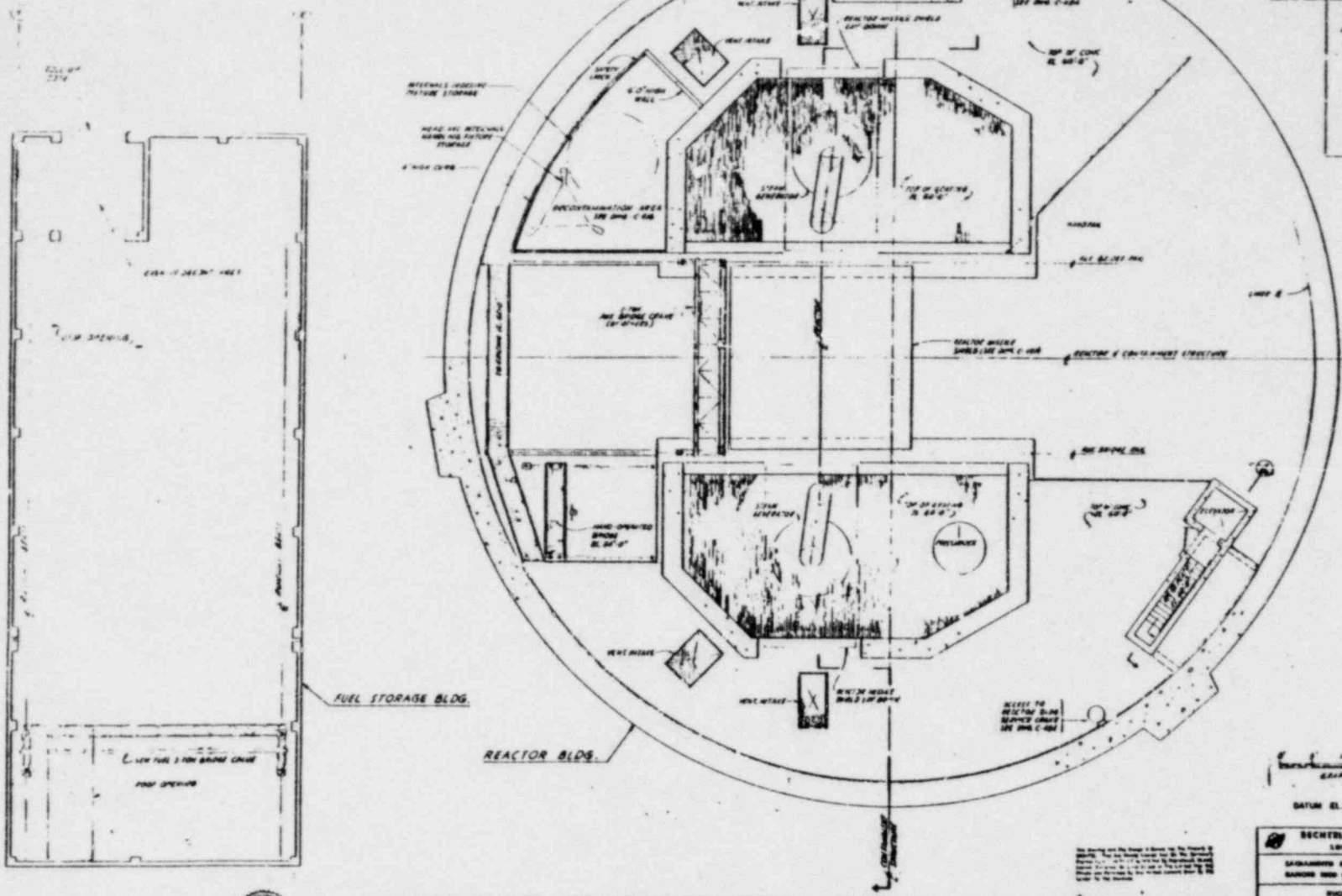
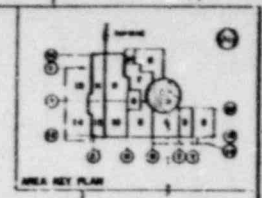
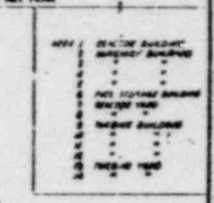
POOR ORIGINAL

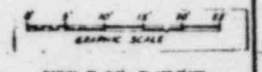
FIG. 5

BASKET CASK TRANSFER PATH (POLAR CRANE)









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GENERAL ARRANGEMENT
PLAN EL. 60'-0"

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POOR ORIGINAL

FIG. 6

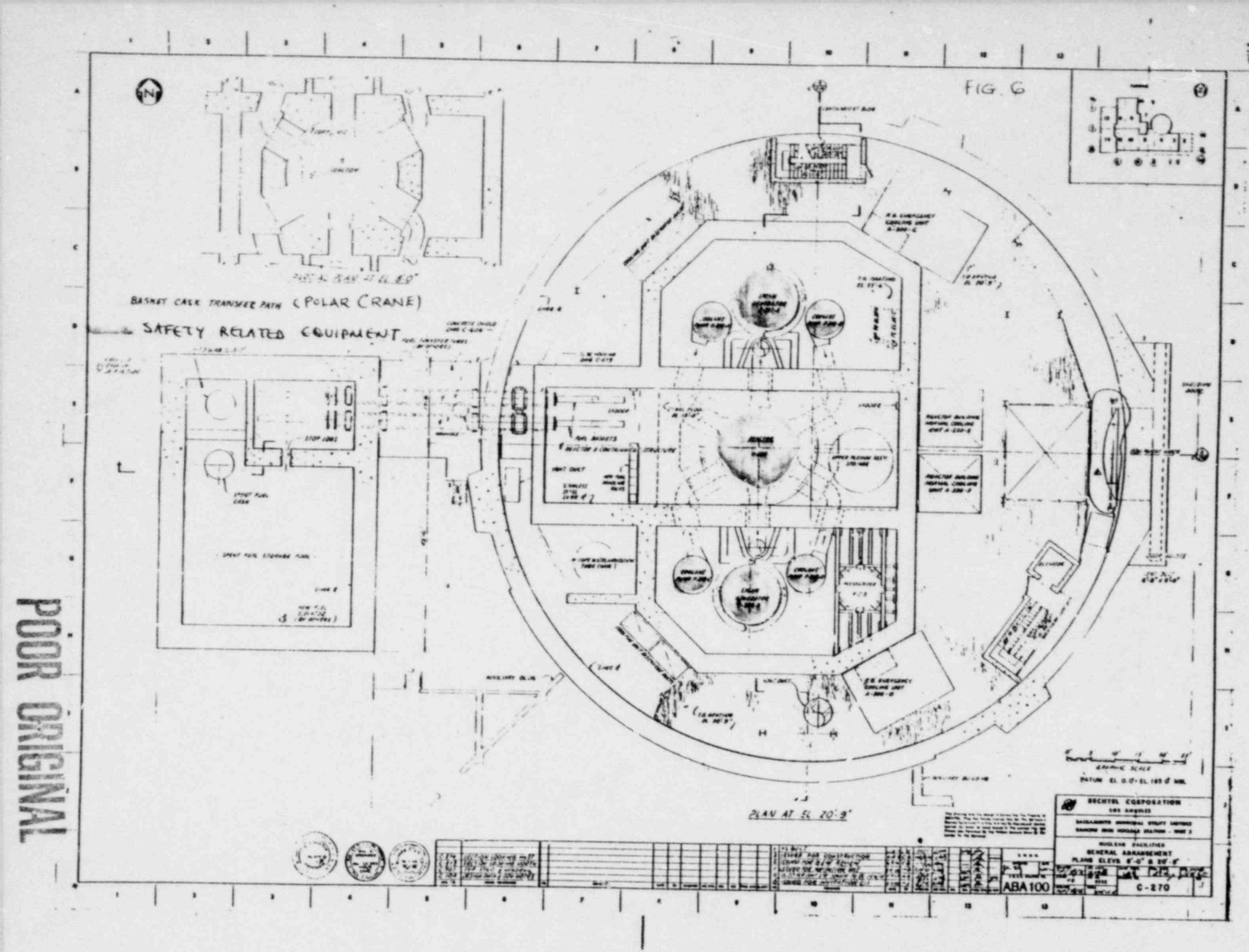
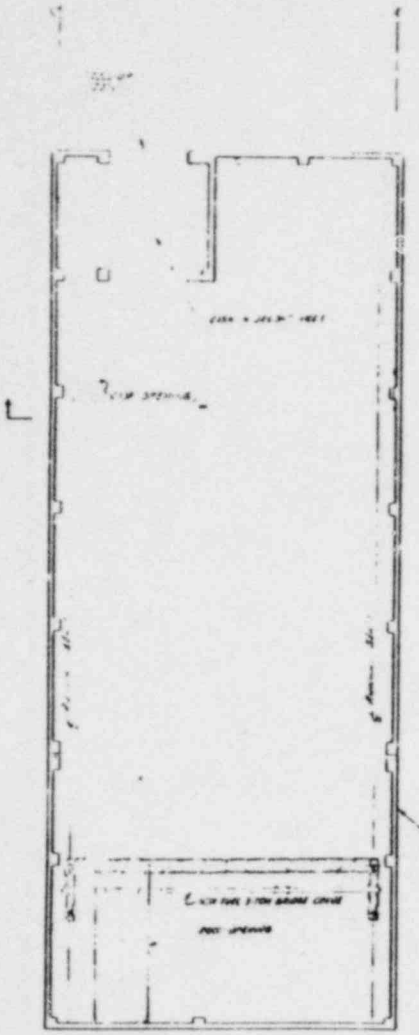


FIG. 7

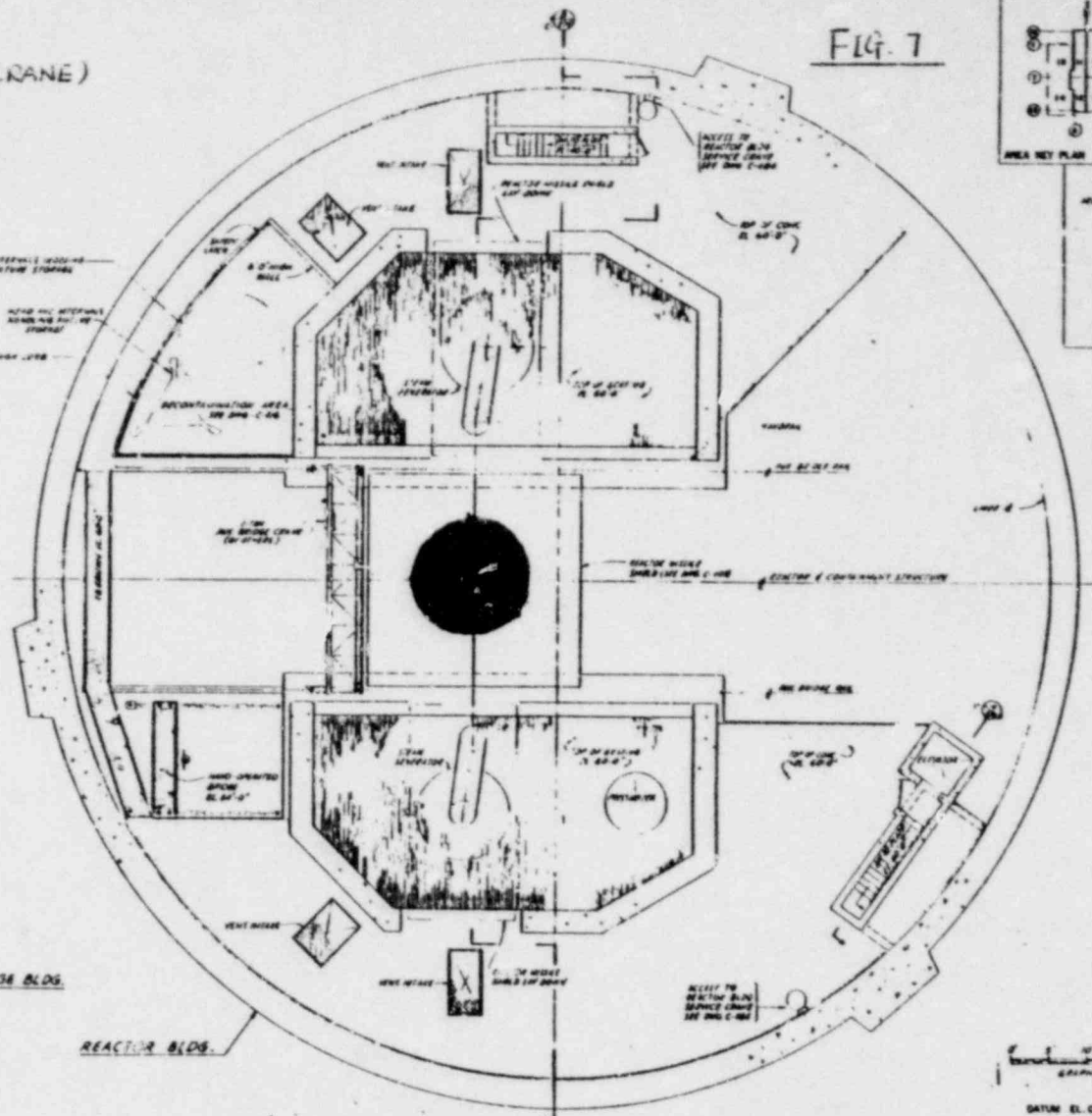
RX HANDLING TOOLS TRANSFER PATH (-POLAR CRANE)

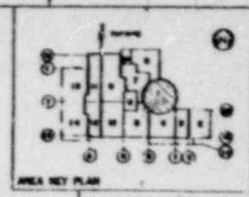
SAFETY RELATED EQUIPMENT

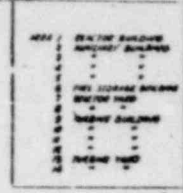


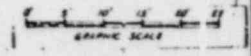
FUEL STORAGE BLDG.

REACTOR BLDG.









DATUM EL. 0.0 = EL. 100'-0" MSL

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RANCHO SECO NUCLEAR STATION - UNIT 1

NUCLEAR FACILITIES
GENERAL ARRANGEMENT
PLAN EL. 69'-0"

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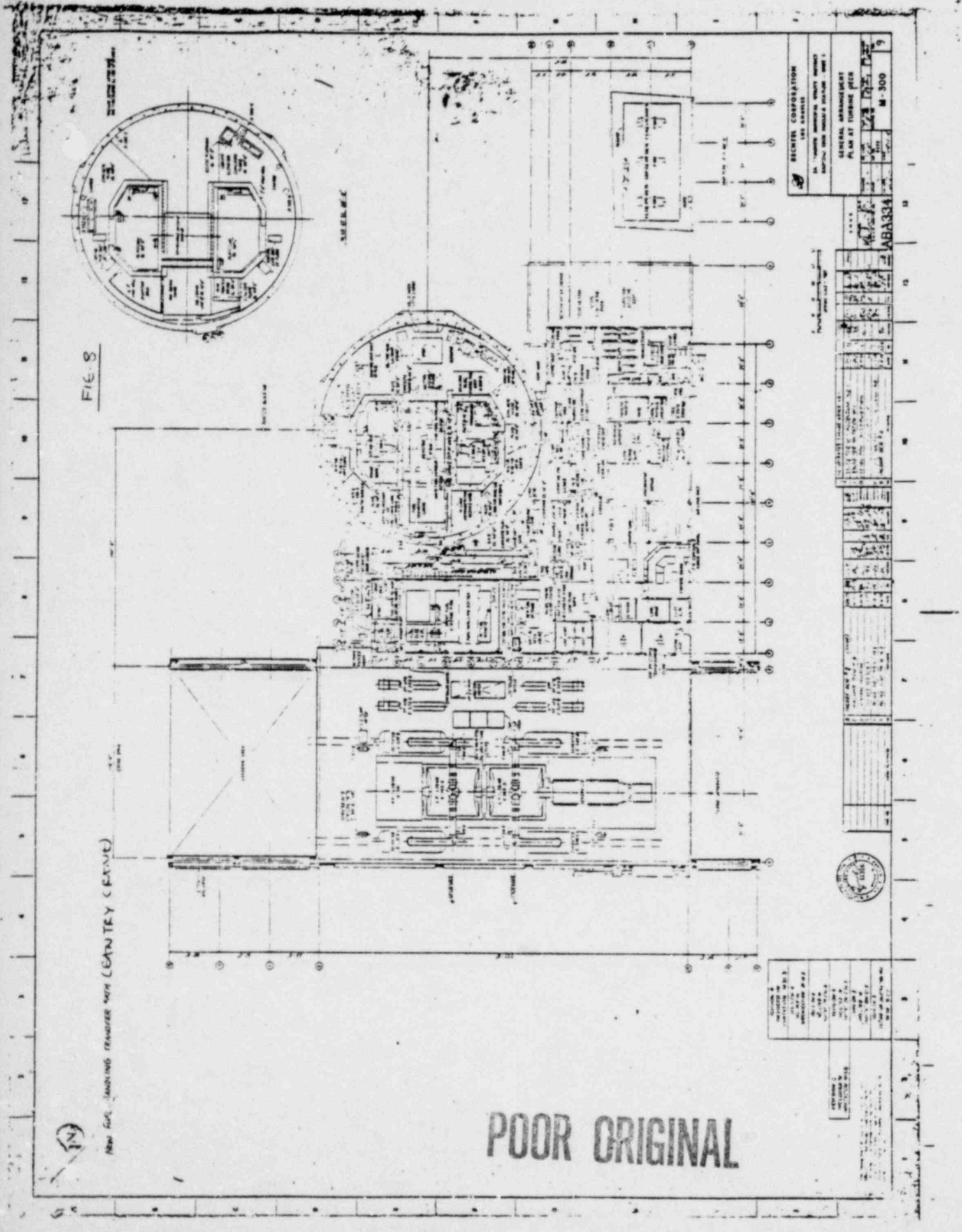
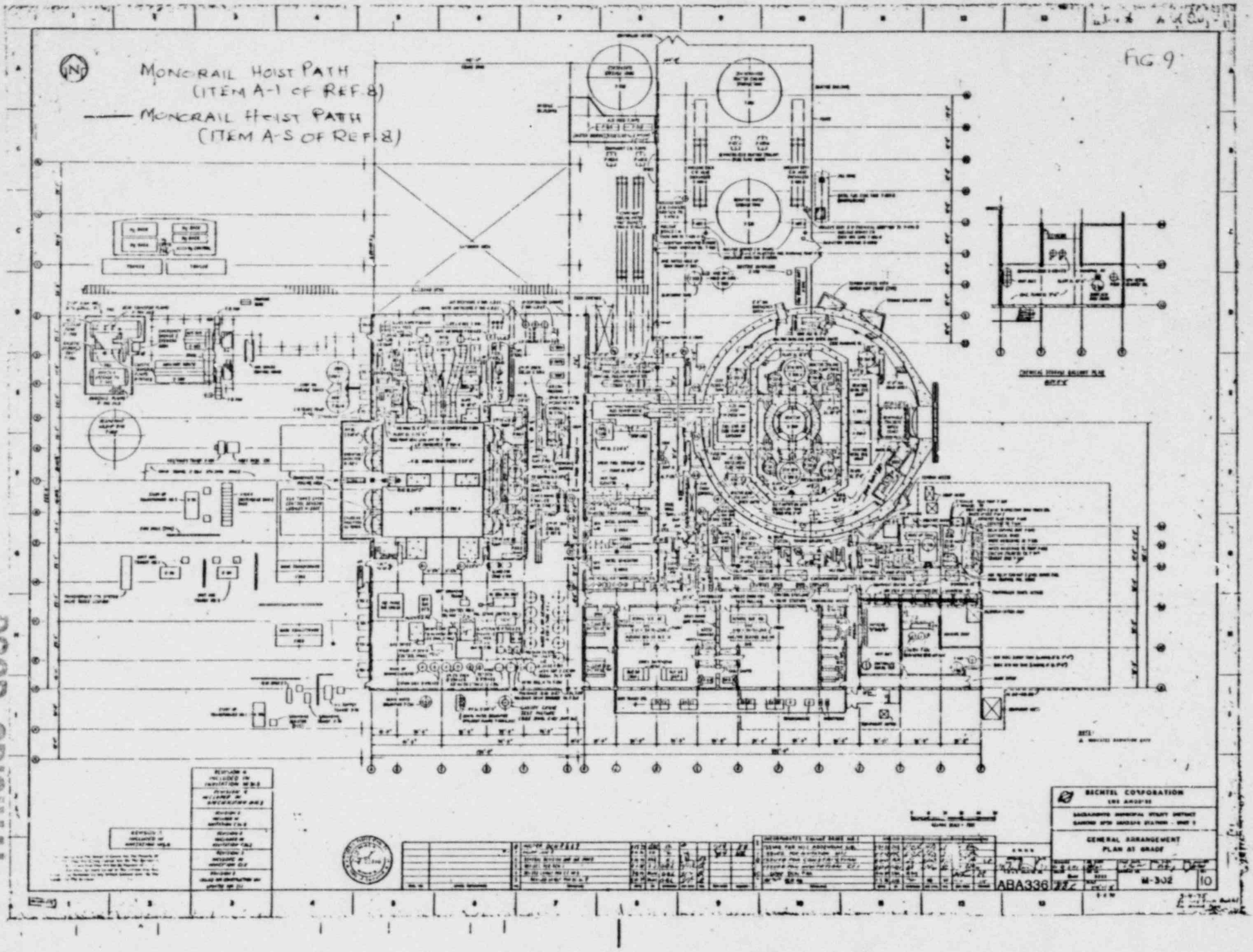
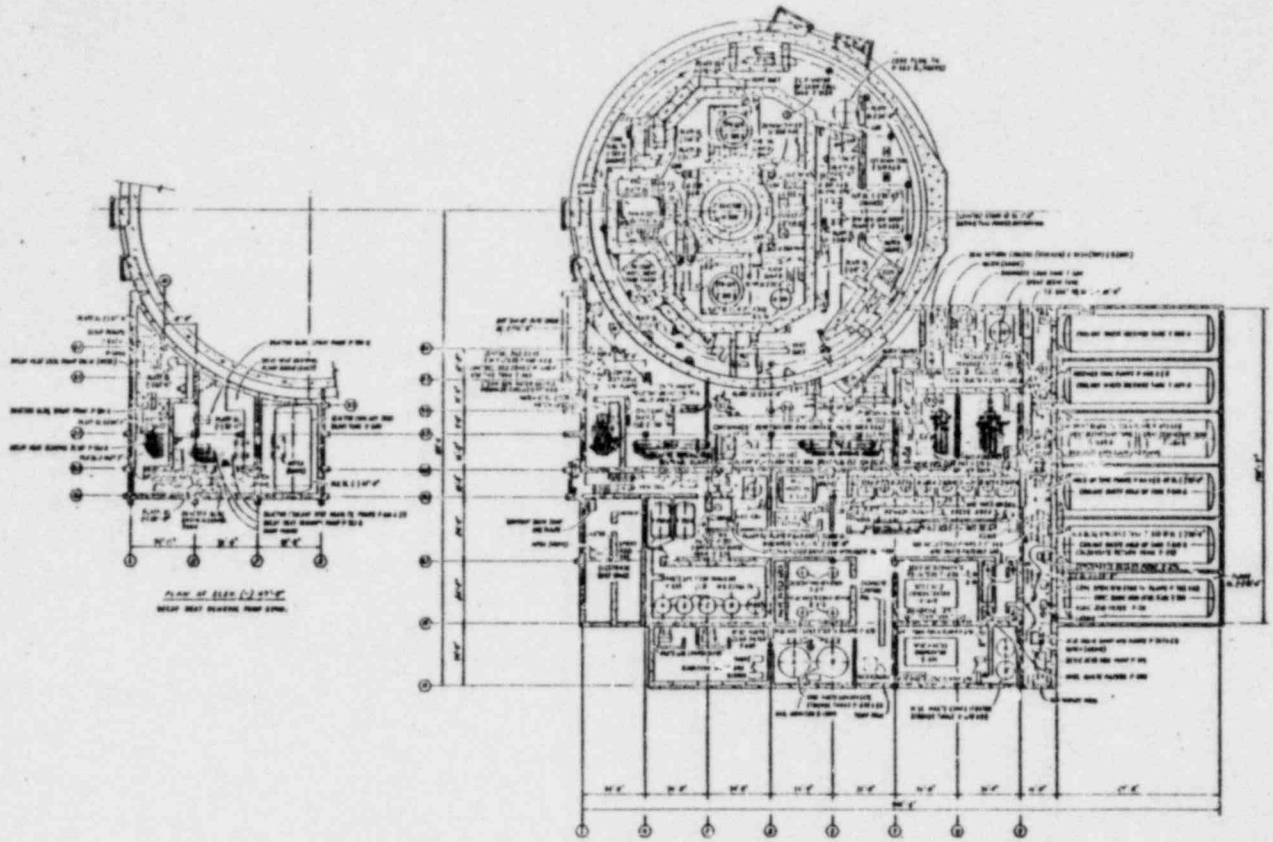




SAFETY RELATED EQUIPMENT

FIG-10



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SACRAMENTO MUNICIPAL UTILITY DISTRICT
RANCHO SECO NUCLEAR STATION - UNIT 1

GENERAL ARRANGEMENT
PLAN BELOW GRADE

M-303

POOR ORIGINAL

3.0 REFERENCES

a. Letter dated 12/22/80 from Nuclear Regulatory Commission to all licensees of Operating Plants.

b. NUREG-0612, Control of Heavy Loads at Nuclear Power Plants, USNRC, July 1980.