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HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

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TITLE

AUTHORIZATION REQUEST FOR POTENTIAL NON-COMPLIANCE
WITH THE AMERICAN STANDARD SAFETY CODE FOR ELEVATORS
DUMBWAITERS AND ESCALATORS

ISSUING FILE

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AUTHORIZATION REQUEST FOR POTENTIAL NON-COMPLIANCE
WITH THE AMERICAN STANDARD SAFETY CODE FOR ELEVATORS
DUMBWAITERS AND ESCALATORS

I. INTRODUCTION

A Third Party inspection of the reactor work platforms was conducted by representatives of the Travelers Insurance Company in 1958. An inspection report submitted by these representatives described hazardous conditions noted and presented a series of recommendations to improve the operational safety of the systems. Project CGI-960, "C" & "D" Work Platform Safety Improvements - All Reactors, was initiated to modify the platforms in compliance with the Third Party recommendations.

The American Standard Safety Code for Elevators, Dumbwaiters and Escalators (A-17.1) is used as a guide by the Third Party in formulating their recommendations. This code is used because there is no other applicable code for this type of equipment. While the work platforms do not and in some cases can not comply with this code because of operational use, every effort is made to comply with the intent of the code.

II. BACKGROUND

The platform modification work includes installation of new emergency brake systems on the platform hoisting shafts. This required replacement of hoisting shafts with longer shafts of slightly larger diameter.

New sprockets were designed for installation on the new oversized hoisting shafts for the initial 105-KE Reactor platform modification work. Old sprockets removed during this work were remachined and installed on new oversize shafts on the 105-KE Reactor platform installation.

Design requirements for the new sprockets were shown on GE Drawing H-1-33964, Sheet #2, and described in the procurement specification, HWS-7240. The design was based on the requirements of ASA Standard B-29.1 - 1950 Transmission Roller Chains & Sprocket Teeth, and the American Standard Safety Code for Elevators, Dumbwaiters and Escalators, (A-17.1) which requires a factor of safety of eight or ten dependent upon the mechanical properties of the material used. The specification required radiographic inspection of the sprocket castings and required a minimum casting classification of Class 2 in accordance with ASTM E-71-52. A later study of operating conditions relaxed this casting classification from Class 2 to Class 3.

Attempts at open bid procurement of the sprockets on the basis of the above drawing and specification resulted in "no bids". Vendors objected to the radiographic inspection and possibility of rejection of sprockets not meeting the specification requirements. The sprockets

were finally procured through negotiation from the original sprocket vendor on a "replacement in kind" basis. The new sprockets and the old, remachined sprockets were inspected on plant. Radiographic inspection of the new sprockets resulted in classification of two castings as Class 2, five as Class 3 and five as Class 4. The radiographic inspection of the old, remachined sprockets resulted in ASTM casting classification of Class 5 for all twelve sprockets.

III. SCOPE

The purpose of this document is to describe a potential code variance on work platform hoisting shaft sprockets. The term "potential variance" is used because Facilities Engineering after thorough investigation, believes that the sprockets do meet intent of code requirements. A Third Party Inspector, however, may take exception to the use of the sprockets and charge a variance from code requirements. It is also the purpose of this report to request the approval of General Electric Company Management for the potential deviation from code.

IV. POTENTIAL CODE VARIANCE

The American Standard Safety Code for Elevators, Dumbwaiters, and Escalators A17.1, Rule 208.3, "Factor of Safety For Driving Machines and Sheaves" states the following: "The factor of safety to be used in the design of driving machines and in the design of sheaves used with hoisting and compensating ropes shall not be less than":...

- a. "Eight for steel, bronze or for other metals having an elongation of at least fourteen percent in a length of two inches."
- b. "Ten for cast iron, or for other metals having an elongation of less than fourteen percent in a length of two inches."

"The load to be used in determining the factor of safety shall be the resultant of the maximum tensions in the ropes leading from the sheave or drum with elevator at rest and with rated load in the car."

On the work platforms the "sheaves" are roller chain sprockets and the "ropes" are roller chains.

ASTM Casting Classifications of 4 and 5 are the result of inclusion, voids, hot tears and shrinkage cracks in the sprocket castings.

Design dimensions to achieve calculated internal design stresses and desired factors of safety are based on sound materials, free of defects.

Radiographs of the major casting defects which resulted in the Class 4 classification together with sketches to indicate locations of the defects were made available to the vendor engineering personnel, IPD, Research & Engineering and to Vitro Engineering.

The findings which resulted from the three independent investigations are as follows:

A. Vendor Engineers (Union Chain Company)

- a. Radiographs are of good quality and definition.
- b. A factor of safety of five was used in design. (Indications are that this factor is based on yield rather than ultimate stress used in the Vitro Engineering calculations.)
- c. The vendor considers the castings good and satisfactory for our service.

B. Research & Engineering

The analysis by Research and Engineering verified that the anticipated loadings will not produce stresses which could be considered dangerous in sound castings.

C. Vitro Engineering

A stress analysis performed by Vitro Engineering Company to evaluate sprocket design was based on the following:

Design Torque	40,000 ft-lb.
Actual Torque, Maximum. due to effect of one brake active w/ platform moving downward	28,300 ft-lb.
Material - Cast Steel per ASTM A27, Class U60-30	60,000 psi
Ultimate Shear Stress	36,000 psi
Yield Tensile Stress	30,000 psi
Compression (based on design torque load of 40,000 ft-lb.) in web at juncture of web and hub, (based on minimum web thickness)	2,400 psi; factor of safety = 25
Hub on shaft	450 psi; factor of safety = 134
Shear (based on design torque load of 40,000 ft-lb)	
Torsional shear at juncture of web and hub	1,200 psi; factor of safety = 30
Torsional shear in hub at key	1,400 psi; factor of safety = 26
Shear in key (assuming loose fit between sprocket and shaft)	5,100 psi; factor of safety = 10

Tensile (based on design torque
load of 40,000 ft-lb)
Tensile stress in hub 4,000 psi; factor of safety = 15
Tensile stress in hub, due to
maximum interference shrink fit 5,000 psi; factor of safety = 12

The factors of safety shown above were calculated by Design Engineering. It is noted that the lowest factor of safety encountered is 10 and is a shear stress on the key with a loose fit sprocket and did not account for the reduction in this stress resulting from the interference fit between sprocket and shaft.

A review of the three independent investigations revealed the following:

- a. Stresses generated throughout the sprocket casting under anticipated maximum loading are not excessive for sound castings.
- b. The maximum loading used in the stress calculations is 30 percent greater than required by code.
- c. Radiographs indicate the major defects to be in approximately the same location in all sprockets at one end of the hub on or adjacent to the keyways. Defective area represents approximately one-sixth the length of the hub. Depth of defects are not known.
- d. An analysis of the sprocket design which ignores the defective areas in the hub reveals a calculated factor of safety of 10 which is in excess of the code requirement of 8.
- e. "Hot Tears" in the hubs of certain of the sprockets could propagate under repeated shock loadings.
- f. The ASTM casting classification of the old, remachined sprockets is five for all twelve sprockets. This lower quality casting has been in service (at times under severe overload) for approximately ten years.
- g. The new sprocket and shaft assemblies were selectively assembled so that the casting defects are not concentrated in any one set. The old remachined sprockets were all of the same relative quality where selectivity in assembly provided no basic advantage.

With consideration for the nature of the service and the results of the investigation, Facilities Engineering believes the sprockets to be safe for the use intended. With dimensional data on the casting defects not known and thus cross section of sound metal not known it is questionable whether or not the sprockets meet the required code factor of safety of 8. It is in this area where a Third Party may charge a violation to code.

V. BIBLIOGRAPHY

1. Letter, H. W. Heacock to W. Seeburger entitled "Project CGI-960, Platform Hoisting Shaft Sprockets", dated July 1, 1964.
2. Letter, J. E. Boyd to W. P. Nicklason, entitled, "Project CGI-960, Platform Hoisting Shaft Sprockets", dated July 28, 1964.
3. Radiographic Inspection, Job Number F-128, Physical Testing Operation, Field Unit, Hanford Laboratories Department.
4. Radiographic Inspection, Job Number F-171, Physical Testing Operation, Field Unit, Hanford Laboratories Department.
5. Letter, H. W. Heacock to W. Seeburger, entitled, "Project CGI-960, Work Platform Hoisting Shaft Sprockets", dated August 26, 1964.
6. HWS-7240 Procurement Specification for Reactor Work Platform Hoisting Shaft Sprockets, Buildings 105-KE & KW including all Standards and Codes referenced in this Specification.
7. HAPO Drawing Number H-1-33764, Sheet 2, "Jack Shaft Assemblies, "C" and "D" Platforms", Revision Number 5.

Plant Design

JE Boyd:hr

END

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