TESTIMONY OF

CARL R. MEFFORD

RELATED TO

CAPABILITY OF FUEL ASSEMBLIES TO ACCOMMODATE

LOADS APPLIED DURING INSERTION AND REMOVAL

FROM SPENT FUEL STORAGE RACKS

JANUARY 28, 1981

BACKGROUND

My name is Carl R. Mefford and I am employed by the General Electric Company in the Nuclear Fuel and Services Engineering Department in San Jose, California. I have a bachelors degree in engineering from California State Polytechnic University. I have been continuously employed by General Electric Company in the nuclear energy business since 1958 and have 22 years experience in mechanical design of fuel bundles, fuel channels, channel fasteners, control blades, and neutron sources. My current position is Principal Engineer in the Fuel Assembly Design Unit in the Fuel Mechanical Design Subsection. The Fuel Assembly Design Unit is responsible for mechanical design of fuel bundles, channels, and channel fasteners.

INTRODUCTION

As described in the testimony of James D. Gilcrest, there is potential for interference between spent fuel assemblies and the proposed Dresden spent fuel storage racks for the combination of worst case fabrication tolerances and worst case channel bowing. Such interference will result in application of external forces to the affected fuel assemblies as they are inserted and removed from the storage racks.

The purpose of my testimony is to address the capability of General Electric fuel assemblies to withstand the loading described by Gilcrest. My testimony is applicable for all fuel bundles, channels, and channel fasteners supplied by General Electric for use in the Dresden 2 and Dresden 3 reactors.

It does not address fuel components provided by suppliers other than the General Electric Company.

FUEL ASSEMBLY DESCRIPTION

Figure 1 is a sketch of a typical fuel assembly provided by General Electric for use in the Dresden 2 and Dresden 3 reactors. The fuel assembly consists of three major components: a fuel bundle, a channel, and a channel fastener. The channel slips over the outside of the fuel bundle and is bolted to the upper tie plate by the channel fastener as shown in Figures 1 and 2.

The fuel bundle shown in Figure 1 contains 64 rods in an 8x8 array. Other fuel bundles used in the Dresden 2 and 3 reactors contain 49 rods arranged in a 7x7 array. The rods of each bundle type are spaced and supported in a square array by the upper and lower tie plates and seven spacers located equidistant along the length of the rods. The lower tie plate supports the fuel assembly in the reactor core. The upper tie plate has a lifting bail for transferring the fuel bundle from one location to another. Both the upper and lower tie plates are fabricated from Type 304 stainless steel. Two types of fuel rods are used in a fuel bundle: tie rods and standard rods. Both types of fuel rods utilize Zircaloy-2 cladding and end plugs. The tie rod lower end plugs thread into the lower tie plate and the upper end plugs extend through the upper tie plate where hexagonal stainless steel nuts and locking tabs are installed to hold the bundle together. There are eight tie rods per bundle located on the bundle periphery as shown in Figure 1. The tie rods support the weight of the bundle only when the assembly hangs by the upper tie plate lifting bail. The remaining rods in the bundle are standard rods which slip into mating holes in the upper and lower tie plates.

COMPONENT LOADINGS

As described in Gilcrest's testimony, the load path for frictional loads applied to the channel during insertion and removal from the spent fuel storage racks is such that the only fuel assembly components subject to significant loading changes are the upper tie plate, the channel corner gusset, and the channel fastener bolt. The combination of fuel assembly component weights and worst case interference could result in the following maximum loads being applied to spent fuel during insertion and removal from the subject storage racks:

Upper Tie Plate Lifting Bail	1190 lbs.
Channel Corner Gusset	574 lbs.
Channel Fastener Bolt	446 lbs.

As described in the following paragraphs, the above loads are well within the capability of the affected fuel components.

UPPER TIE PLATE LIFTING BAIL

The upper tie plate lifting bail is designed to accommodate a lifting load equivalent to three times the weight of the fuel assembly (3 x 680 = 2040 lbs). The design load of 2040 lbs. is a factor of 1.7 greater than the 1190 lb. maximum load required to remove a fuel assembly from the subject storage racks. In that the 1190 lb. applied load is well below the 2040 lb. design load, it is concluded that the lifting bail will not be damaged during removal of the fuel assembly from the spent fuel storage racks.

CHANNEL CORNER GUSSET

Per Gilcrest's testimony, a load of 574 lbs. could be applied to the channel corner gusset during removal of a fuel bundle from the spent fuel storage racks. General Electric has performed a test wherein the load carrying capability of the channel corner gusset was measured. Deformation of the gusset was essentially elastic up to 3240 lbs. The weld joining the gusset to the sides of the channel failed at 4080 lbs. In that the 3240 lb. load at which yielding occurred is a factor of 5.6 greater than the applied load of 574 lbs., it is concluded that the channel corner gusset will not be damaged during removal of the fuel from the spent fuel storage racks.

CHANNEL FASTENER BOLT

The channel fastener bolt is tightened to a torque of 80 inch-lbs. maximum when the channel is assembled to the fuel bundle. Tightening to 80 inch-lbs. torque produces a tensile load of 1280 lbs. in the 5/16-18-UNC Type 304 stainless steel or Inconel X-750 bolts. Per Gilcrest's testimony, frictional loads applied to the channel during insertion of the fuel assembly into the storage rack could produce an additional 446 lbs. load on the bolt. Thus, the total tensile load in the bolt would be 1726 lbs. However, the certified breaking load of the channel fastener bolts is 3150 lbs. minimum, which is a factor of 1.8 greater than the 1726 lb. maximum load applied during insertion of a bundle into the spent fuel storage racks. Thus, it is concluded that the channel fastener bolt will not fail during installation of fuel into the spent fuel storage racks.

CONCLUSIONS

Based upon the foregoing evaluations, I conclude that the possible interferences described in James D. Gilcrest's testimony do not present any safety problem with respect to fuel assemblies supplied by the General Electric Company.

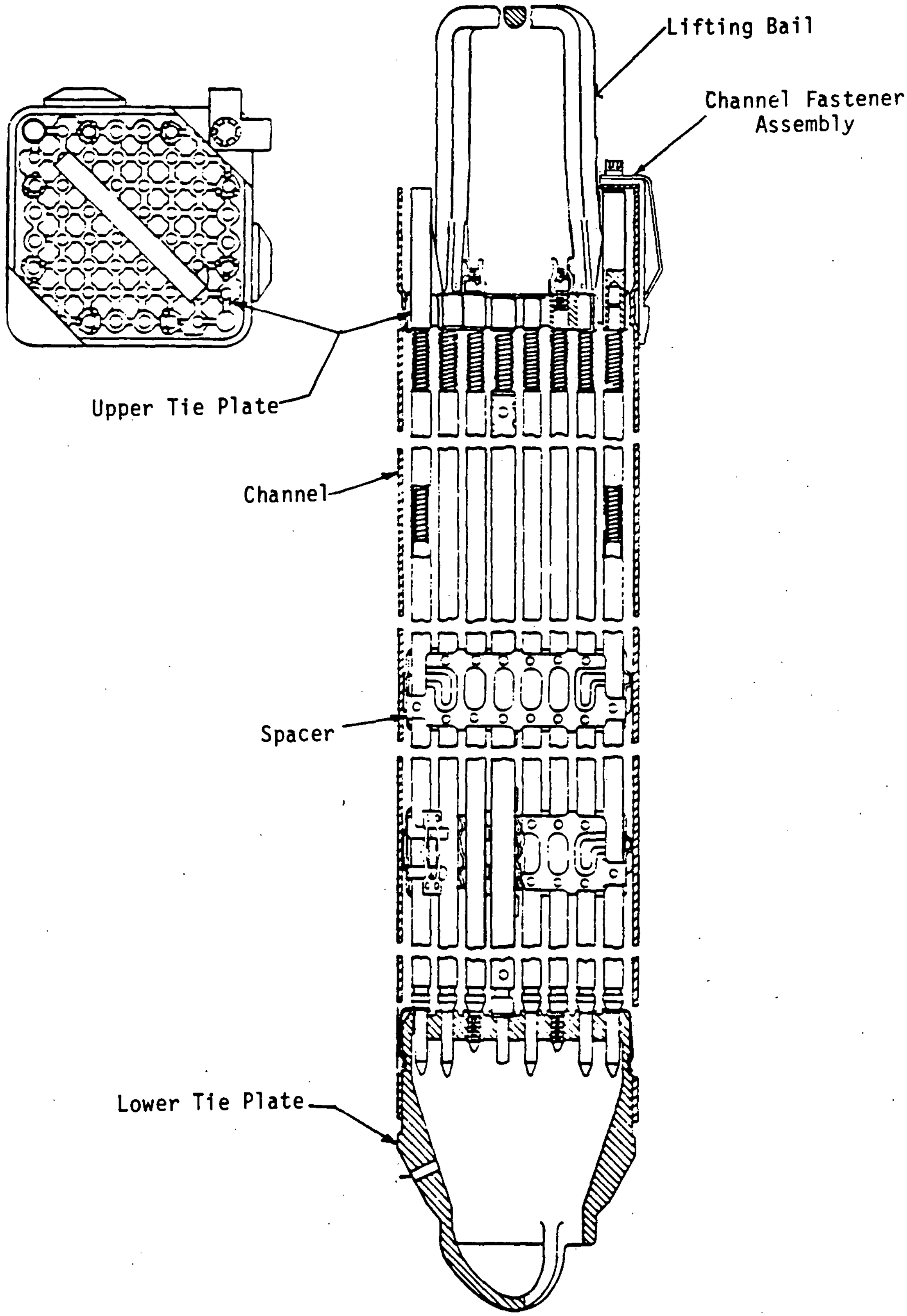

FIGURE 1 FUEL ASSEMBLY

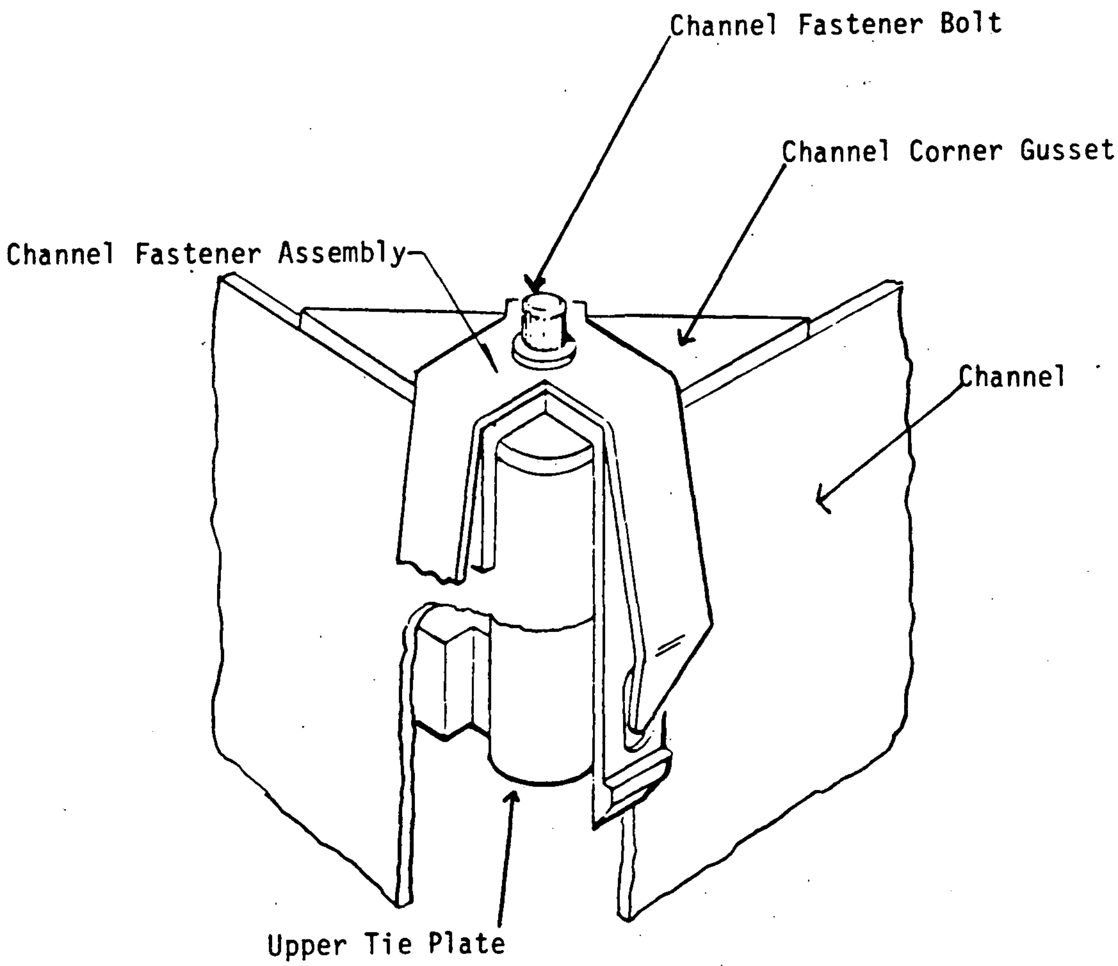

FIGURE 2 CHANNEL FASTENER ASSEMBLY