melibdinum alloys, the description of the alloys suggests that they are something pretty close to stainles steel. Is that right?

WITNESS SPATARO: No, that is wrong. The reason I changed it to a family is that we used a number of different alloys of the same family type in order to make our manufacturing. If I can elaborate on that just a little, the coolers themselves are made of an alloy called AL6X. It is Allegheny Ludlum's alloy. It has 6 molybdenum percent ~~xxxxxxxxxx~~. It gives the maximum resistance to pitting corrosion.

However, that alloy cannot be made in large molybdenum sheet or piping form because of the high ~~xxxxxxxx~~ content. The water boxes of the fan coolers and the attendant piping are made of an alloy called alloy 20 modified, manufactured by ~~xxxxxxx~~ Cabot Corporation. This alloy is approved for ~~xxx~~ use by the ASME Boiler and Pressure Vessel Code.

The rest of the piping system, however, is made of an alloy called 904L. Both 904L and alloy 20 mod have approximately 3 and a half to 4 percent molybdenum ~~xxxxxxxxx~~ in them. The reason for 904L, which is manufactured by the ~~xxxxxx~~ Uddeholm Corporation in Sweden, and by Inco here in the United States, was the relative availability of the material in large quantities, such

as elbows, tees, straight runs, or piping.

We could not get the Cabot alloy in large quantities quickly enough to put our systems in, so we changed over to a very similar alloy, and that is the reason why I mentioned them as a family of alloys.

Your basic question was whether or not they were equivalent to stainless steel. As I understand you to mean stainless steel, this would be the straight 18 chrome, 8 nickel alloys. The answer would be no, because these have an appreciably large amount of nickel, of the range of at least 23 to 28 percent. The chromium is comparable, if slightly higher.

However, the molybdenum content coupled with the nickel is what gives us our pitting corrosion resistance.

JUDGE SHON: I guess the way in which I thought they might be similar to stainless is, are they or are they not subject to intergranular stress corrosion cracking when exposed to aqueous solutions of chloride ion? That is the reputation of stainless steel.

WITNESS SPATARO: No, they are not. If I may elaborate, stainless steels have that problem due to something which we call sensitization. The carbon content in the stainless steel during welding and heat

treating operations migrates to the grain boundaries, where it then ties up with chromium in the neighboring grains.

This leads to a depletion of the neighboring grains from the chromium content. When that chromium content drops below 11 and a half percent, approximately, the alloy becomes less than stainless, if I can use that term, and is subject to the intergranular attack, chloride ions being the most prevalent ions which can then break down the chromium oxide layers on the surface of the stainless steel, and attack these depleted areas.

The use of high nickel and high molybdenum alloys prevents this particular degradation of the material during fabrication from occurring. Hence, we do not feel that we should have any intergranular attack during the operation or lifetime of the alloys.

JUDGE SHON: Thank you. That was going to be my next question, whether they could have been sensitized in any way during the process.

WITNESS SPATARO: No.

JUDGE SHON: No. With regard to the portions of the system which originally were cement lined mild steel, have these portions been inspected and protected? Mr. Rothstein told us that in the other

JUDGE PARIS: What causes the oxygen depletion under the silt? Is the metal oxidizing, or what?

WITNESS SPATARO: The anerobic bacteria, as I understand, are sulfate producing or sulfate reducing. This sulfate combines with the copper oxide, which is the main passive protection for the copper alloys. It changes this to copper sulfate. The copper sulfate then becomes cathodic with respect to the remaining copper oxide.

This reaction reduces the amount of -- well, actually, increases the amount of oxygen necessary to keep the protection of the alloy consistent. Once I have depleted the oxygen under the silt, because it cannot be replenished from the flowing water above the silt level, I then do not have any more protection for my copper alloy, meaning I do not have any more copper oxide, or in various patches I do not.

This small cell, if we can call it that, causes the pitting reaction to proceed such that I continue to break down the copper oxide until I get to the virgin material underneath. Once I do that, the pitting proceeds at some corrosion rate.

JUDGE PARIS: Okay. I think that is the kind of detail we need. Thank you.

JUDGE GLEASON: All right, gentlemen. The