*Short term test facility results for a narrow range of conditions show no discernible effects of solution composition, vapor space or direct immersion placement, or temperature.≅*

## ***MAIN ISSUE*** — CAN LONG TERM CHANGES IN CONDITIONS OVERTURN THIS?

### UNIFORM CORROSION

*Question 1a* — Plausible Mechanisms

1) *Defect Sweeping as described in Attachment*

**Passive film – Film with high vacancy density — enhanced ionic transport)**

***Plausible when conditions change over time.***

*2) Vacancy Build-up as described in Attachment*

***Different rates of dissolution of alloy components – vacancies at alloy - passive film interface causing film disruption. More likely to occur at discrete sites – localized corrosion.***

***Plausible for failure by localized corrosion (Question 2)***

*3) Debris Accumulation as described in Attachment*

**Passive film transformed into a film composed of corrosion products of hydrated metal ions. Film is probably result of Cr depletion. Such films may be anion selective, thereby promoting local attack.**

***Plausible for failure by localized corrosion (Question 2)****Question 1a* — Plausible Mechanisms (continued)

*4) Incipient Transpassive Behavior as described in Attachment*

**Thermodynamics predicts that if potentials become transpassive, the film's Mo and Cr dissolve — leading to an unprotective film. Process is promoted by high pH.**

***Plausible if conditions lead to transpassive potentials.***

*5) Gaseous oxidation — additional mechanism*

**The formation of thicker layers by oxidation mechanisms that occur in gaseous environments (steam and/or air). These layers may not be protective when changes in repository conditions result in the formation of aqueous solutions with $Cl^-$ ions resulting in localized corrosion.**

***Plausible when conditions change from gaseous to aqueous solution environments.***

***Question 2a* — Experiments and/or Theory to Assess Validity of Mechanisms**

- ***Experiments and theory on effects of environmental changes on the increase of potentials to transpassive values leading to the dissolution of alloy components in the passive layer***

- ***Gaseous oxidation studies in steam and/or air at temperatures 100-250C to determine nature of films produced over long times and whether these films can resist localized attack in aqueous solutions containing aggressive anions***

# LOCALIZED CORROSION

## *Question 2b* — Localized Corrosion Mechanism for Initiation and Propagation Not Dependent on Critical Potential ($E_{crit}$)

**Metastable pitting (rapid initiation-repassivation events that can take place $<E_{crit}$) is considered by some of workers (e.g., Burstein) to be the kinetic precursor to stable pit growth.**

**One of a number of proposed ways in which the events of metastable pitting leading to stable pit growth can be described as follows:**

- ***Anion (e.g., $Cl^-$) movement through the passive film at local sites under an electric field***
- ***Formation of metal chloride at discrete sites at the passive film-alloy interface***
- ***Initiation upon rupture of the film at metal-chloride sites***
- ***Pit growth at exposed site sustained when $Cl^-$ ions under diffusion control can prevent repassivation***

**Crevice corrosion is considered by some to be also dependent on metastable initiation-repassivation events to sustain growth.**

*Question 2c* — **Experiments and Theory to Investigate Issues of 2b**

- ***Experimental studies of metastable pitting by, for example, electrochemical noise at environmental extremes that may develop in the repository***

- ***Theoretical treatment of the effect of environment on $Cl^-$ ion transport through the passive layer under an electric field to examine the build-up of metal chloride at sites of local film disruption***

- ***Theoretical treatment of such events as those above in hot gases (air and steam)***