# Marine Atmosphere Stress Corrosion Cracking RIRP Issue

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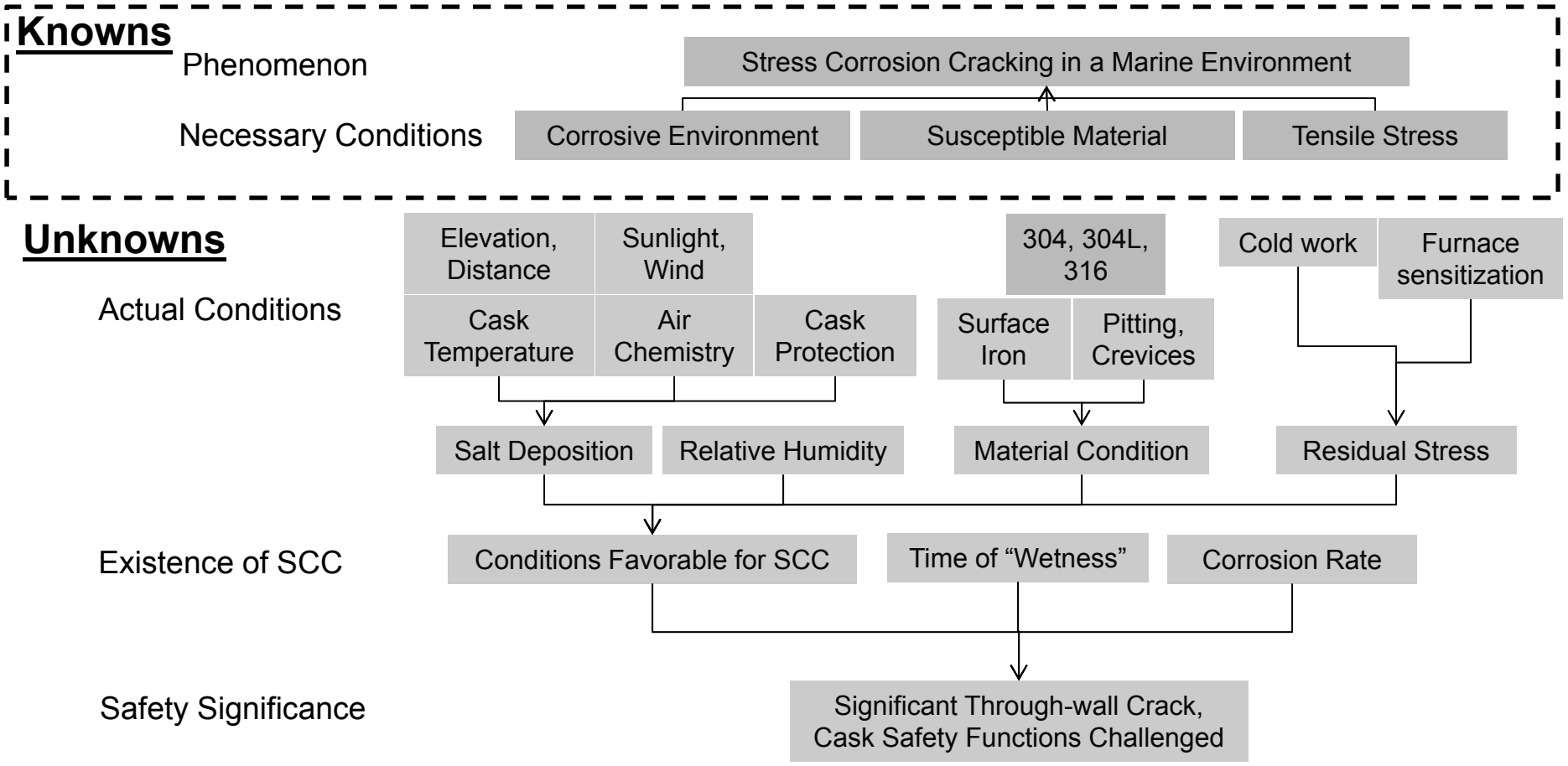
# Agenda

- RIRP Scope
- Overview of current knowledge
- Solving the near term issue
- Solving the long term issue

# RIRP Problem Statement and Scope

- **Problem statement: there is insufficient data available to determine under what conditions and within what time scales SCC may occur**
- **The scope of the RIRP is:**
  - **Define the conditions defining a "coastal marine atmosphere"**
  - **Estimate the time scales within which SCC could be expected based upon actual atmospheric and cask conditions**

# Phenomenon is understood, its significance on the safety functions of casks is not





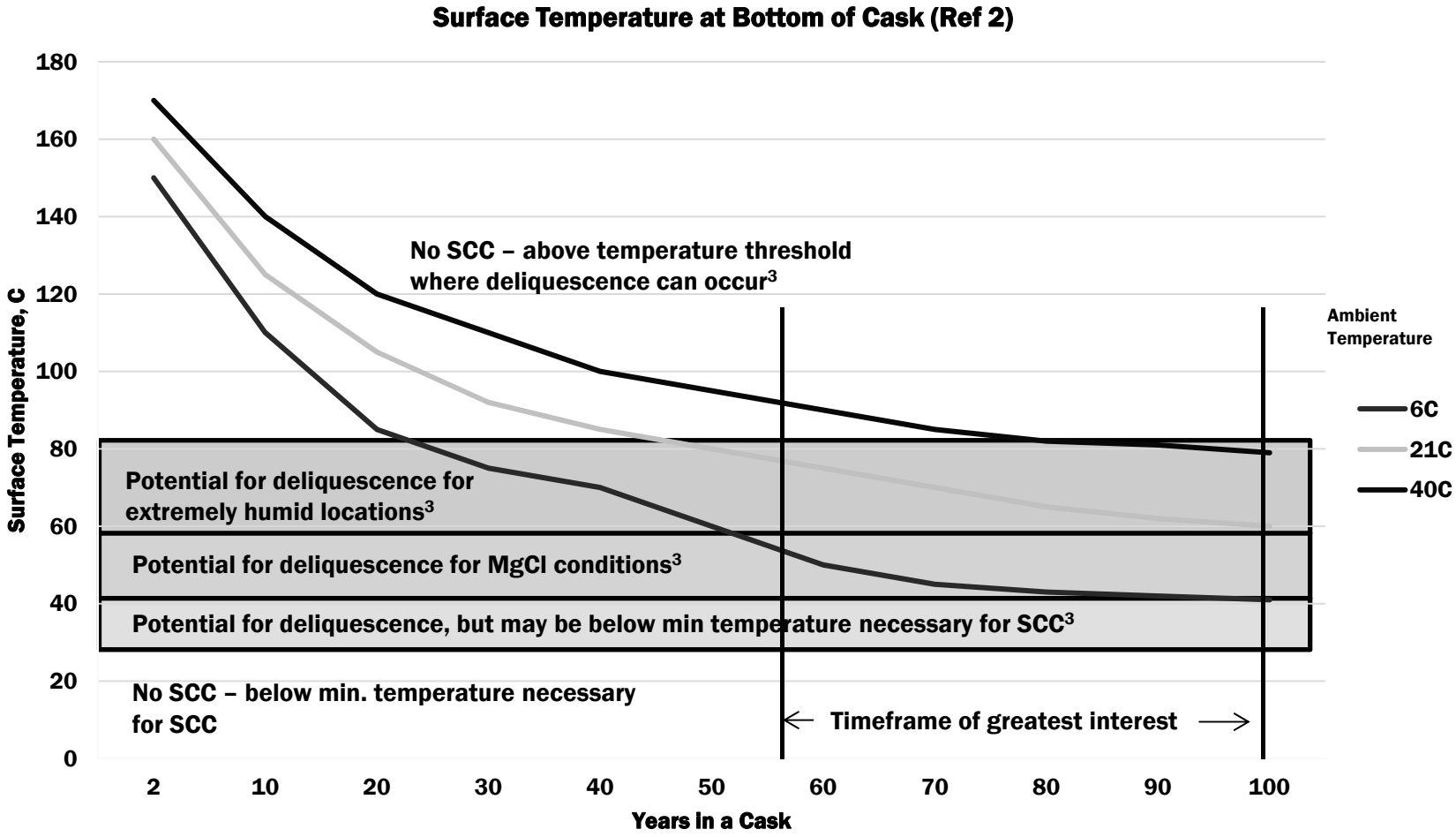
References

1. "Effects of Marine Environment on Stress Corrosion Cracking of Austenitic Stainless Steels", EPRI-1011820, Sep. 2005
2. "Climactic Corrosion Considerations for Independent Spent Fuel Storage Installations in Marine Environments" EPRI-1013524, June 2006
3. Atmospheric Stress Corrosion Cracking Susceptibility of Welded and Unwelded 304, 304L, and 316L Austenitic Stainless Steels Commonly Used for Dry Cask Storage Containers Exposed to Marine Environments", NRC NUREG/CR-7030, Oct. 2010

# Deliquescence

- The process of dissolving or becoming liquid through the absorption of moisture in the atmosphere
- Affected by:
  - Temperature (surface and ambient)
  - Humidity
- If chlorides in solid form deliquesce on the SS canister and stress is present, SCC can occur above ~30$^{o}$C surface temperature

# Example Determination of Time Scale for Potential Marine Atmosphere SCC





References

1. "Effects of Marine Environment on Stress Corrosion Cracking of Austenitic Stainless Steels", EPRI-1011820, Sep. 2005
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# Current Status

- **Available data do not suggest that MA SCC has occurred or will occur soon**
  - **Conservative data suggest soonest initiation time is 40 years**
  - **Oldest loaded stainless steel canister is 22 years**
  - **Realistic estimates are much longer time frames**
- **MA SCC <u>initiation</u> does not equal a loss of safety function**
  - **Time between initiation and propagation allows for mitigation**
  - **Potential for through-wall crack depends on thickness**
- **Opportunity exists to collect and evaluate additional data**
  - **Preventive actions today would not be appropriate because insufficient data to support what actions would be effective**

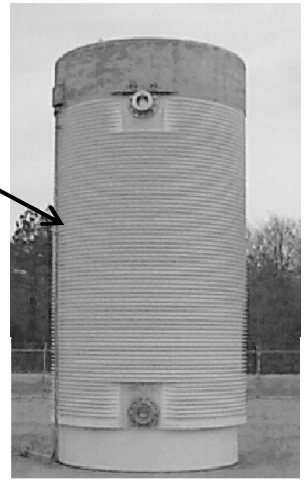
# Ongoing Research and Data Collection

## Determine which Sites are in Marine Atmosphere

- Site environment studies
- Parametric study on temperature, humidity, air chemistry, etc. profiles

## Investigate Actual Conditions

- Visual
- Relative humidity at cask surface
- Actual surface temperature vs. calculated
- Tensile stresses
- Lead time to acquire tool
- Affected by environment and protection

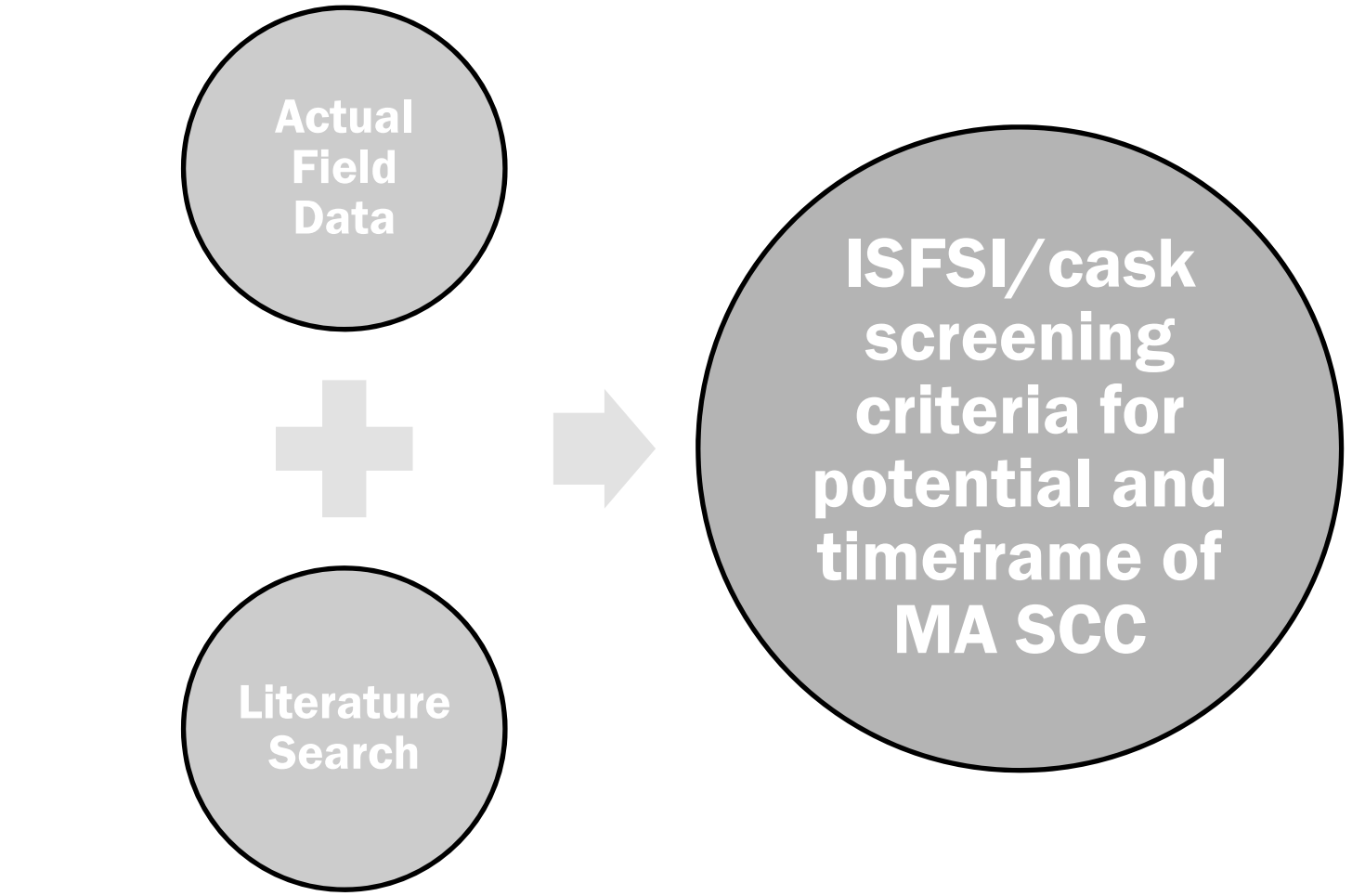


## Simulate SCC in laboratory

- Model air chemistry and humidity at cask surface
- Prepare samples with representative material and stress characteristics
- Reproduce actual salt deposition and other conditions
- Measure corrosion and cracking rates at different temperatures

- Data from Multiple Sites, Designs and Loading Configurations are required to determine stress threshold, salt air concentration threshold, temperature threshold, individual cask conditions
- Total scope of research estimated to take 5 or more years

# Near term actions to inform the ISFSI/cask screening criteria



# Screening Criteria to Address Time Scale

- Screening criteria under development
  - Expected broad review by ISFSIs
  - Summary results to determine
    - ISFSIs with necessary conditions
    - Commonalities of sites potentially affected
    - Grouping of ISFSIs by SCC initiation time frame
- Industry to share screeningresults with NRC