U.S. EPR GSI-191 Head Loss Testing

AREVA NP Inc. and the NRC
January 27, 2010

Objective

- **To keep NRC apprised of AREVA NP's approach and progress toward addressing RAIs related to GSI-191.**

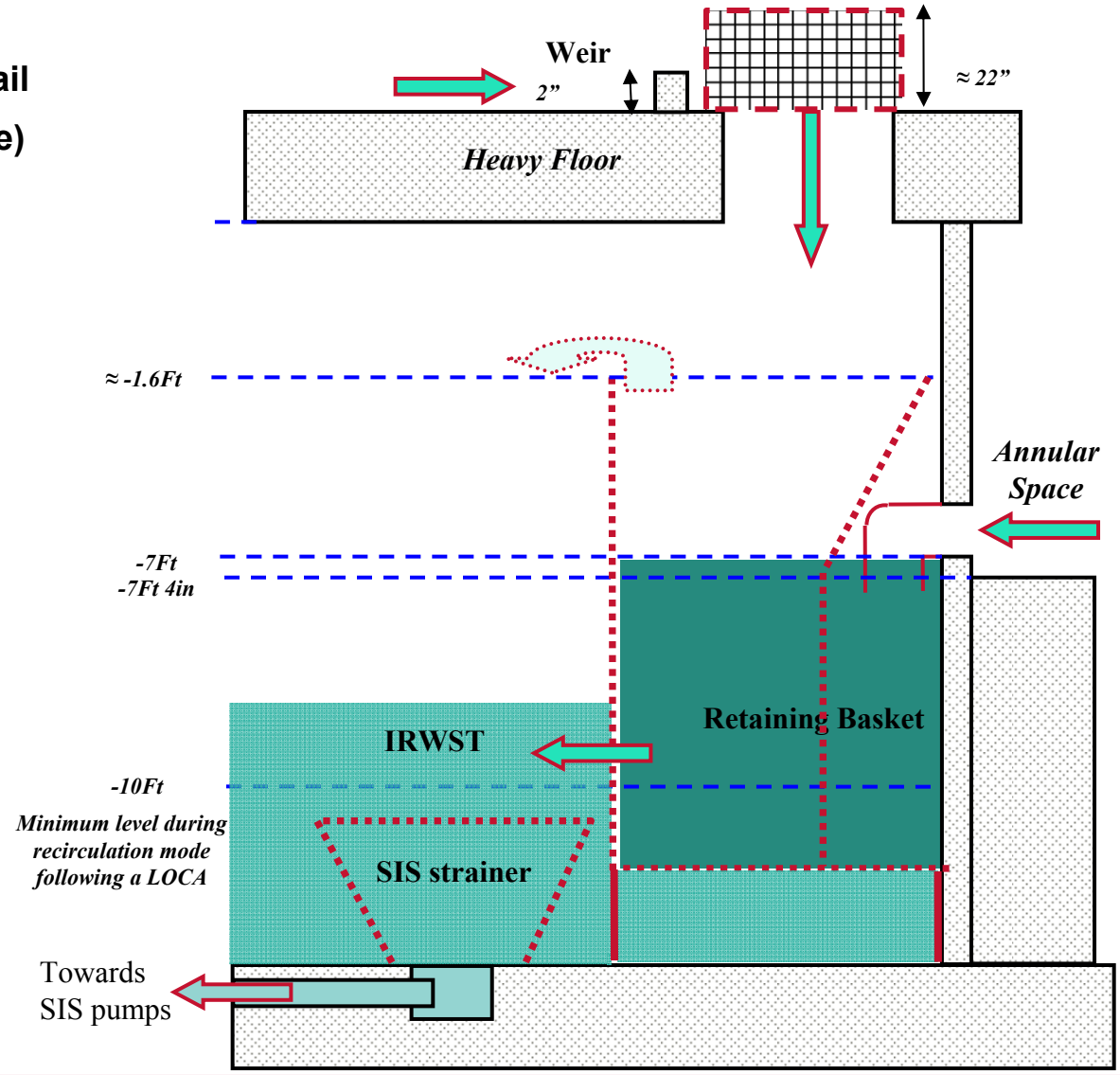
Sump Performance Strategy

- Three tiered debris interceptor approach
- Trash racks/weir
- Retaining basket
- Strainer

Sump Performance Strategy

Design Detail

(not to scale)



Debris Generation Methodology

- **The debris generation evaluation process includes the following and is based on NEI 04-07 and associated NRC safety evaluation:**
  - **Insulation Inventory (types, locations, amounts)**
  - **Pipe Break Location Selection**
  - **Break Jet Destruction Model Zones of Influence (ZOIs)**
  - **Insulation Debris Quantities (targeted and destroyed)**
  - **Non-insulation Debris Types and Quantities Generated**
  - **Debris Characteristics of Debris Generated**

Debris Generation Methodology

- Development of the U.S. EPR debris source term employs the guidance of NEI 04-07 and associated NRC safety evaluation
- The U.S. EPR containment design is low fiber
- The debris generation evaluation performed consistent with methods used for operating plants

Test Facility Description

- **The test facility:**
  - **Flume tank 35.5 ft long x 10.5 ft high x 5 ft wide**
  - **Suction chamber at one end with a slanted strainer**
  - **Recirculation pump (max flow ~ 400 gpm)**
  - **Piping with valves connecting the pump to the suction chamber and the simulated break above the heavy floor**
  - **Retaining basket (RB) with a screen (identical in mesh size to the sump strainer), top open (~ 17 ft)**
  - **Instrumentation for measuring differential pressures, flow rates, and temperature**
  - **System to inject a defined amount of debris**

Strainer Head Loss Testing

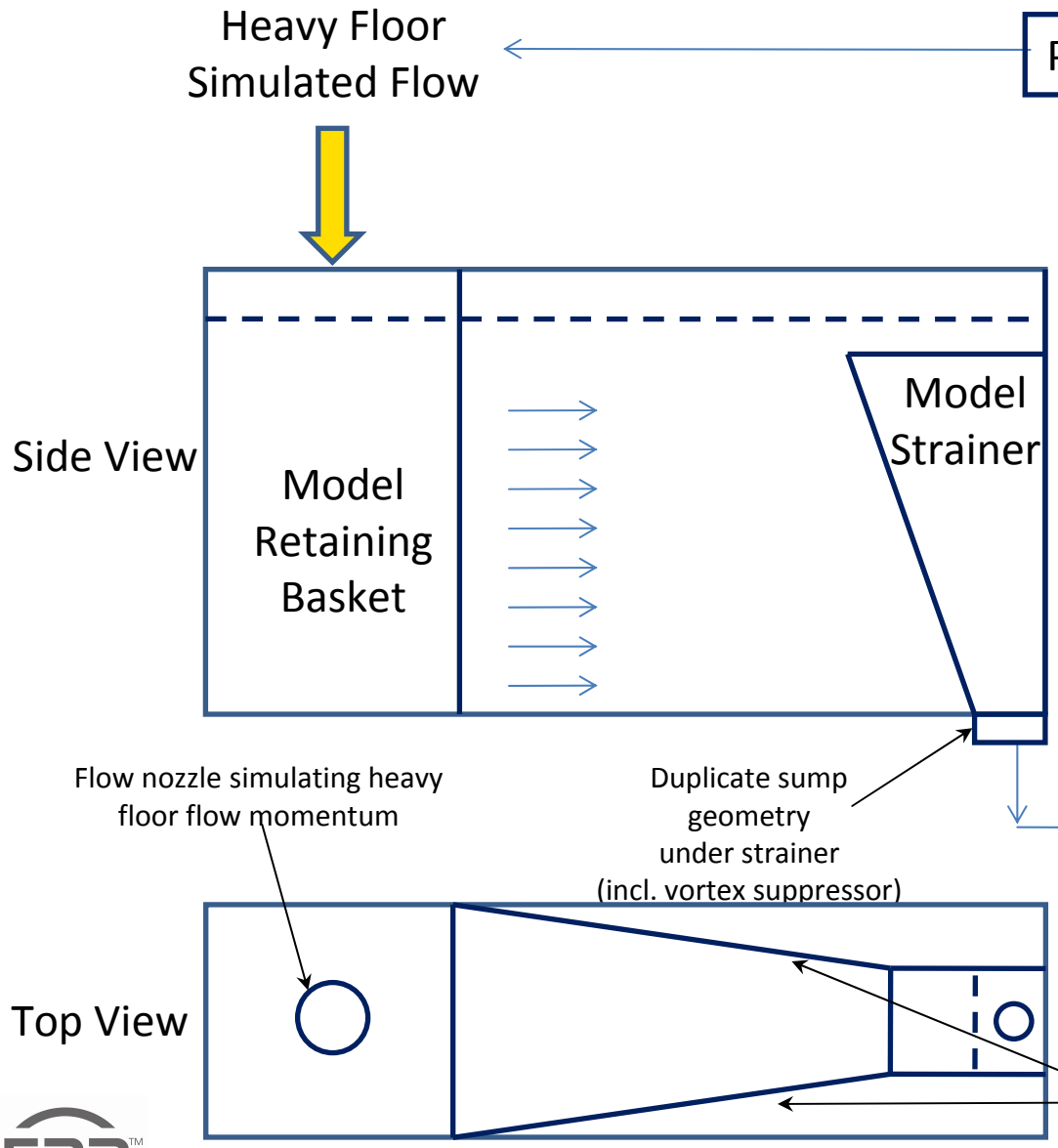
- **Head loss testing protocol:**
  - **Debris introduction system will accommodate debris sequencing**
  - **Chemical precipitant addition will be performed**
  - **Bypass sampling will be performed**

Previous Head Loss Testing

- Five tests were planned
  - Clean strainer head loss
  - Debris transport
  - Design basis debris load
  - Fiber only
  - Thin bed

Previous Head Loss Testing

- Facility scaling was selected at 9.4%, except for height which was 1:1 (within test apparatus limitation)
- Facility was constructed based on this scaling



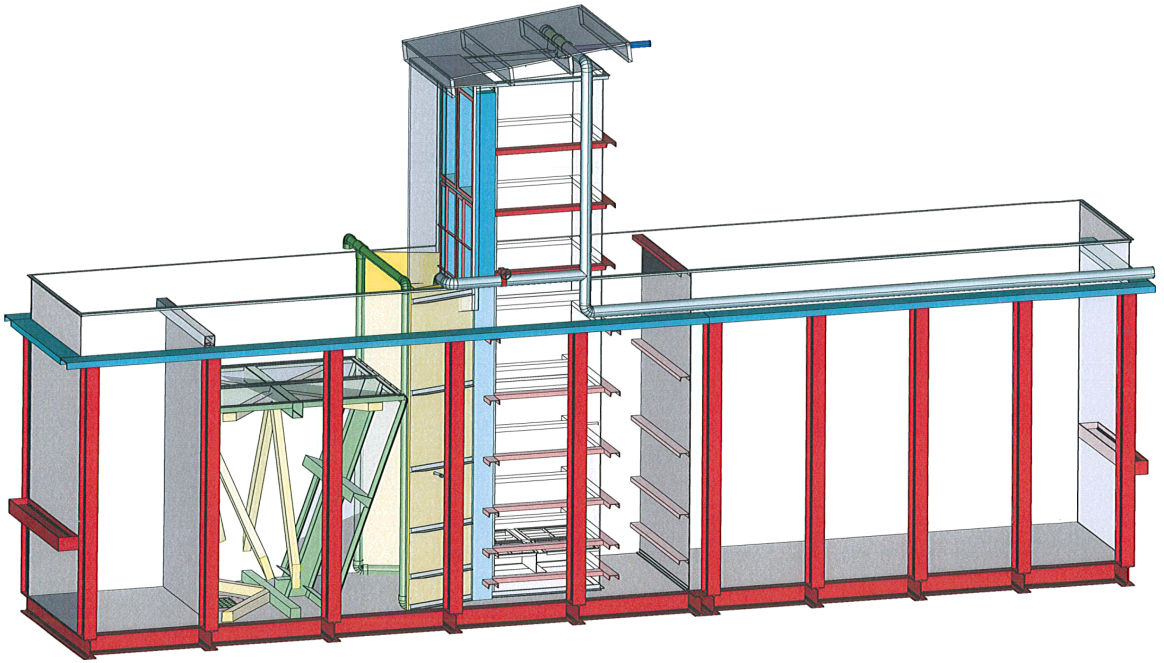
- Heavy floor break flow simulated by flow nozzles approximately 8 ft above the water surface
- Simulated heavy floor break flow represents max. momentum flow achieved falling discharge distance
- Only retaining basket side facing strainer open for flow (via screen)
- Model strainer takes up entire width of flume
- Flow guiding walls between retaining basket and strainer to yield a conservative transport velocity between strainer and retaining basket
- The distance between model strainer and retaining basket at the minimum distance in containment (scaled).

Previous Head Loss Testing

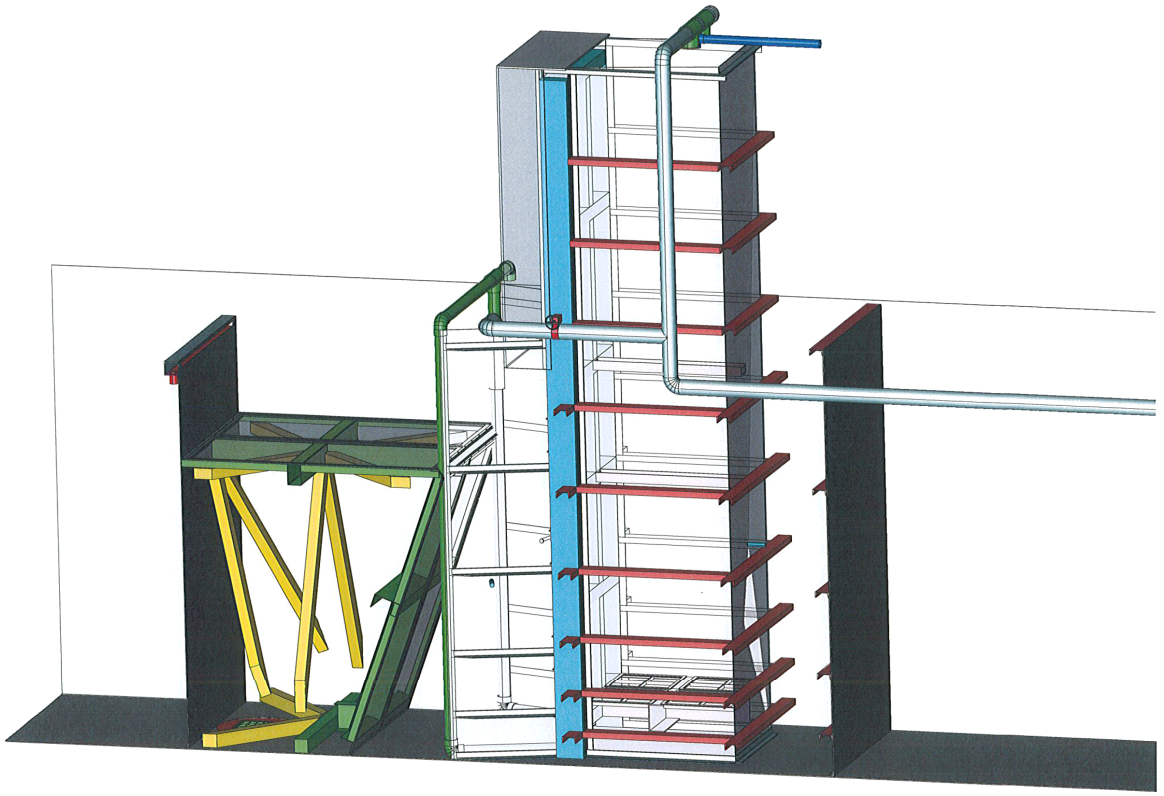
- **Debris was introduced directly into the retaining basket (RB)**
- **During debris introduction, the water volume in RB rose**
- **RB level continued to rise until it reached the test apparatus height limit**
- **Test was terminated prematurely due to test apparatus limitation**

Head loss test facility will be re-designed and constructed to incorporate full height RB

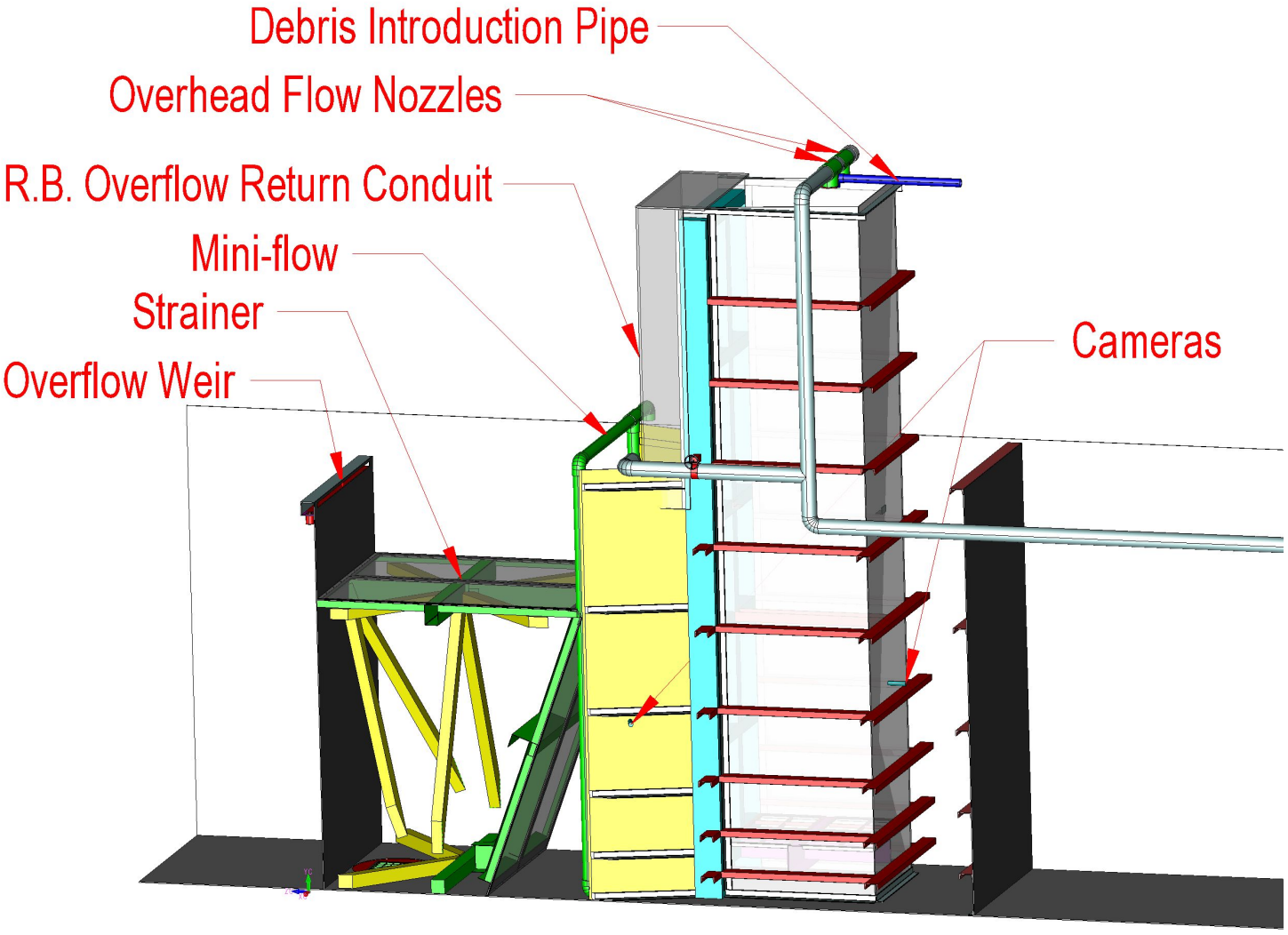
Head Loss Test Facility Re-design



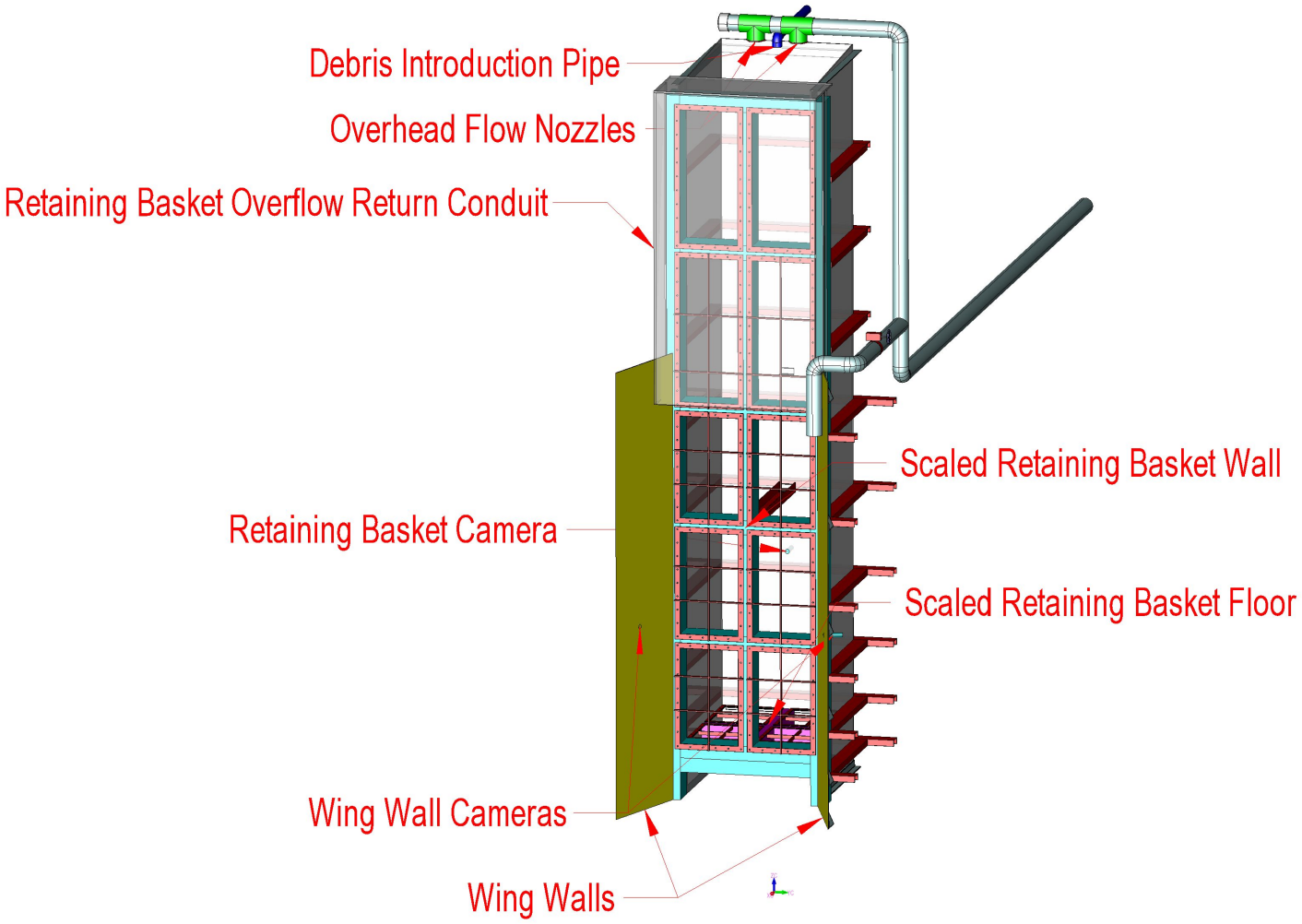
Overview of Basket-strainer Combination



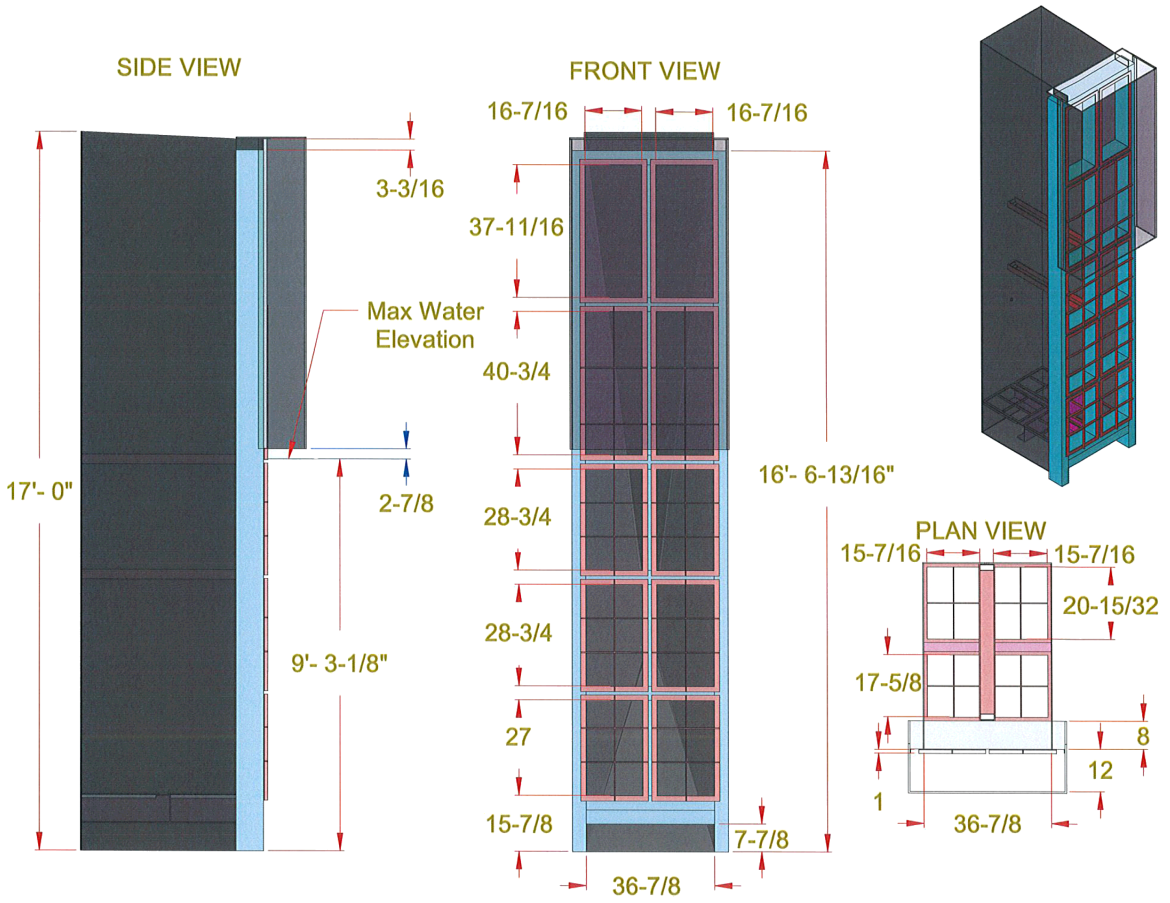
Auxiliary Piping and Features



Retaining Basket Details



Scaled Retaining Basket with Overflow Return Conduit

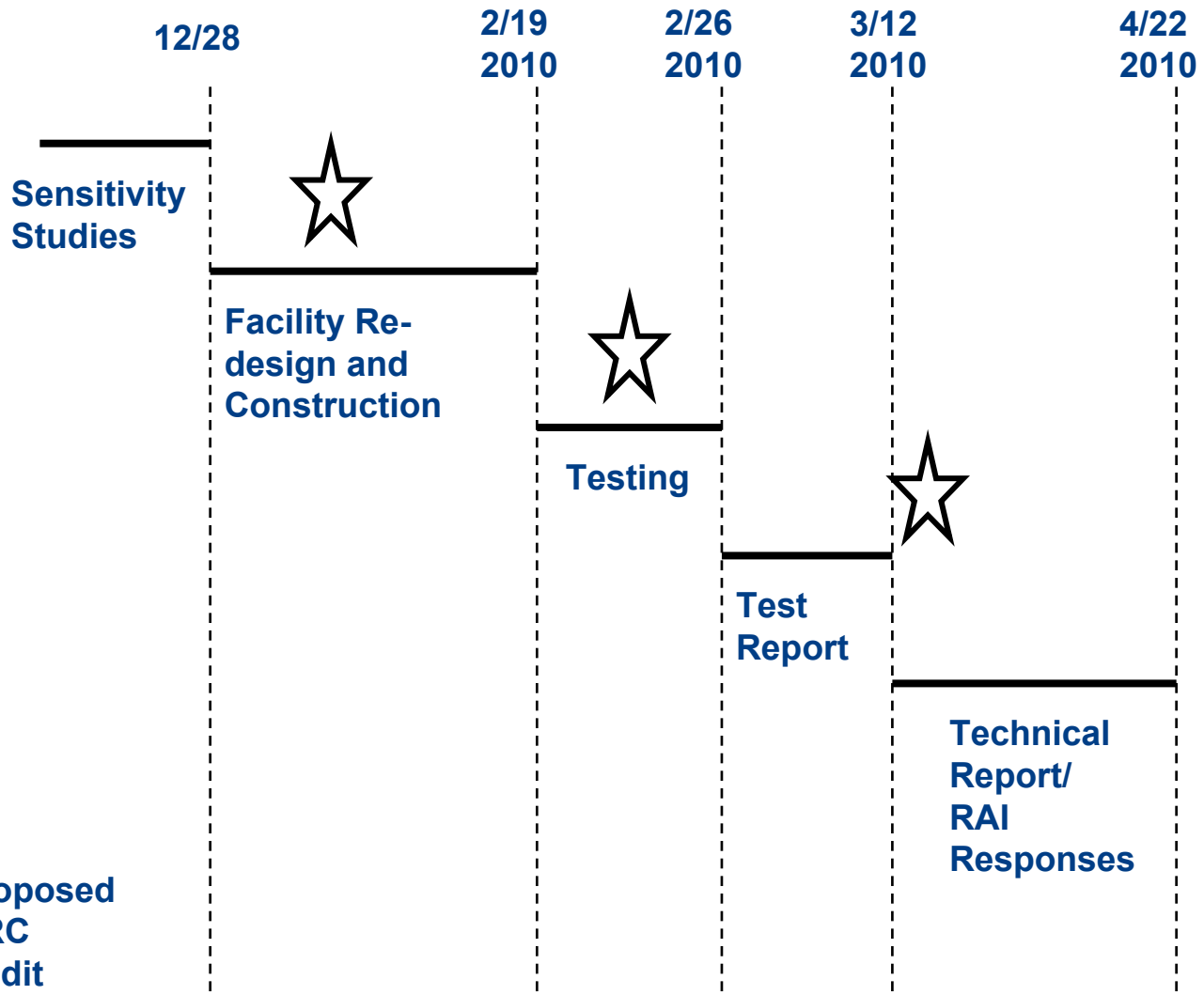


Head Loss Test Facility Re-design

- **Changes to facility include**
  - **Steel construction**
  - **Full height RB**
  - **Modeling of RB floor screen surface**
  - **Debris introduction system**
  - **Improved water level management plan**

Head loss testing representative of U.S. EPR design basis

Timeline


12/28
2/19 2010
2/26 2010
3/12 2010
4/22 2010
Sensitivity Studies
Facility Re-design and Construction
Testing
Test Report
Technical Report/ RAI Responses
Proposed NRC Audit