Kewaunee Power Station
NRC Agenda Setting Meeting

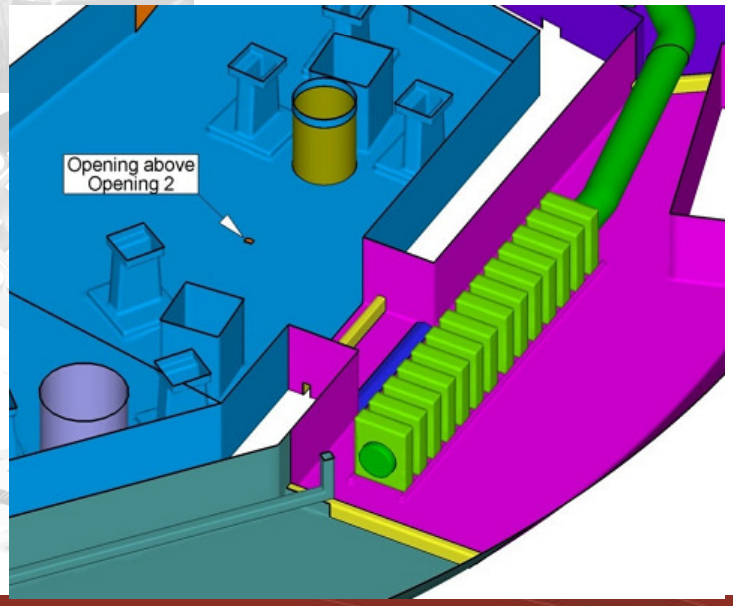
9/15/2009

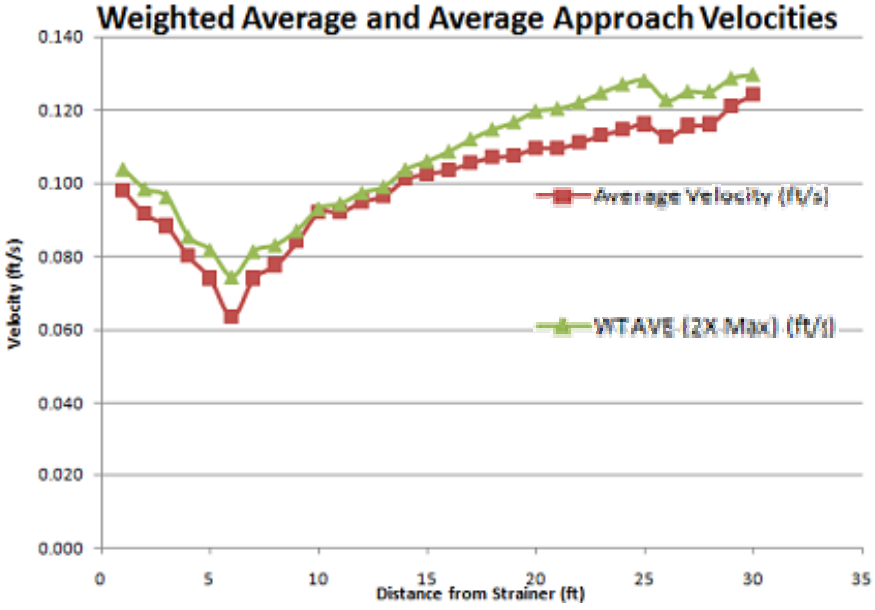
ALDEN

Solving flow problems since 1894

RAI E9j: Concentrated sources of drainage

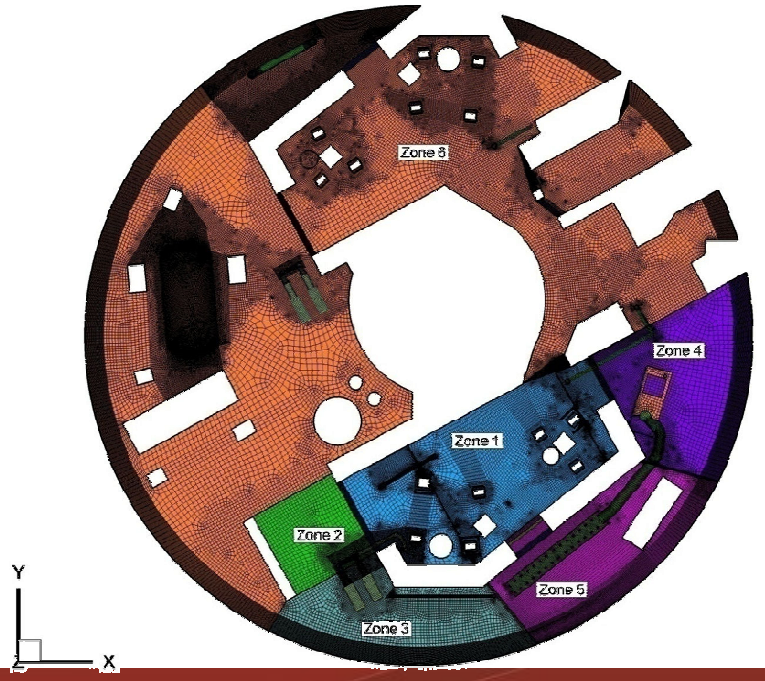
- No concentrated spray and drainage sources are located in the immediate vicinity of the strainer
- The closest source is modeled in the transport calculation and the flume wall calculation
- The influence of the source can be seen in the calculated approach velocity profile
- The drainage source influence was represented in the large flume test





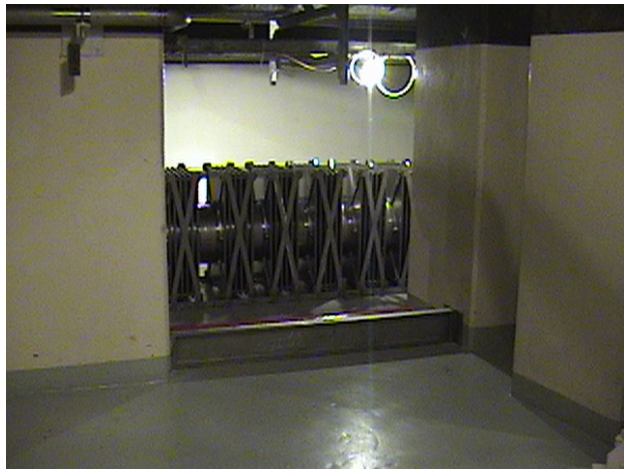
E13a-e: CFD modeling of containment flow

- Simulations were conducted using Fluent and followed the standard calculation methodology
- The standard k-ε model was used for turbulence calculations
- Debris transport calculations were conservatively performed at the water level for the start of recirculation
- High transport fractions were obtained for most zones up to a tumbling velocity of 0.2 ft/sec



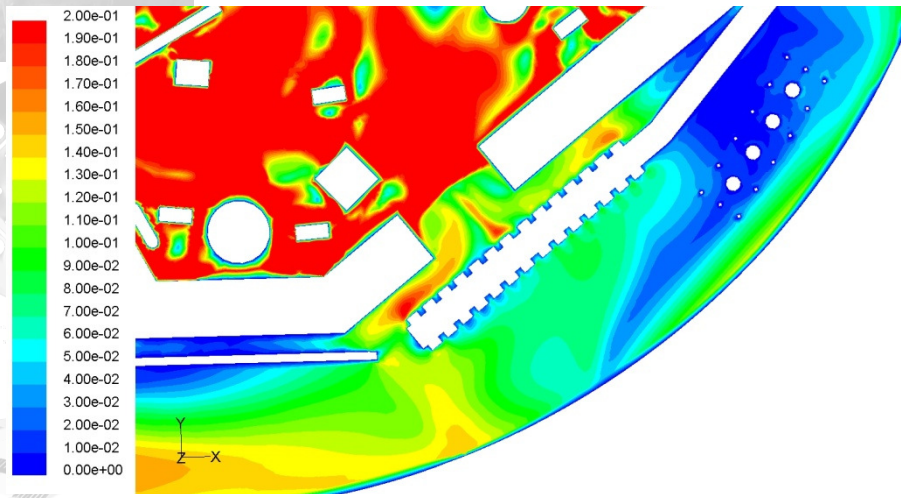
E13a-e: CFD modeling of containment flow

- Detailed accounting was performed to model spray and break flow drainage into the recirculation pool
- Concentrated sources of falling water were treated ideally converting all water potential energy into kinetic energy
- The debris interceptor curb was modeled with few simplifying assumptions
- No assumptions with regard to debris interceptor debris loading were necessary
- No credit was taken for lift-over-curb transport limitations over the debris interceptor curb

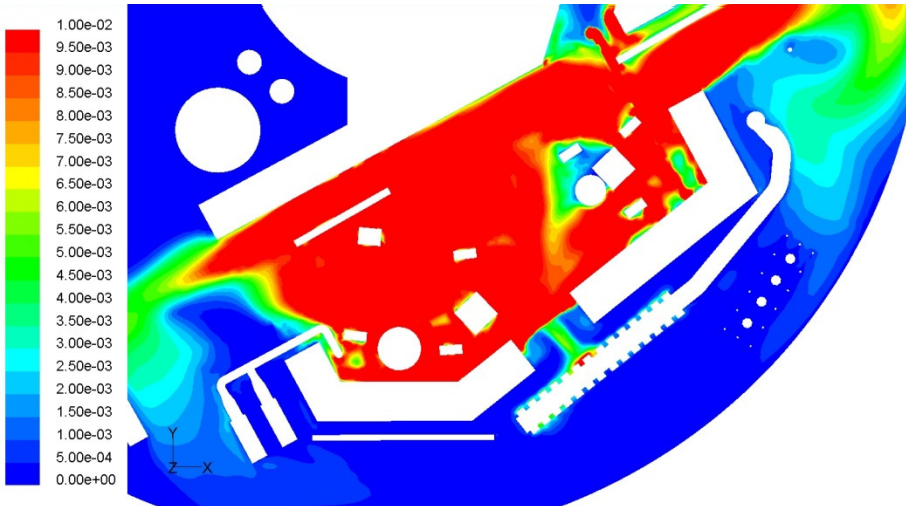


E15: Turbulence in containment and flume / test configuration

- Flume configuration based on long-term recirculation conditions
  - Achieved 14 minutes after recirculation start
- Water level in containment for analysis and test maintained at 40.5”
  - 40.5” is water level for the start of recirculation
  - Actual water depth is more than 2 ft higher for long-term recirculation
- Velocity and turbulence levels in vicinity of strainer are low
- Containment structure divides break flow into three sources distributing break flow momentum



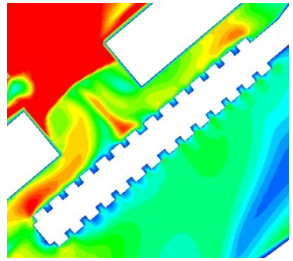
Long-term recirculation velocity magnitude (ft/s)

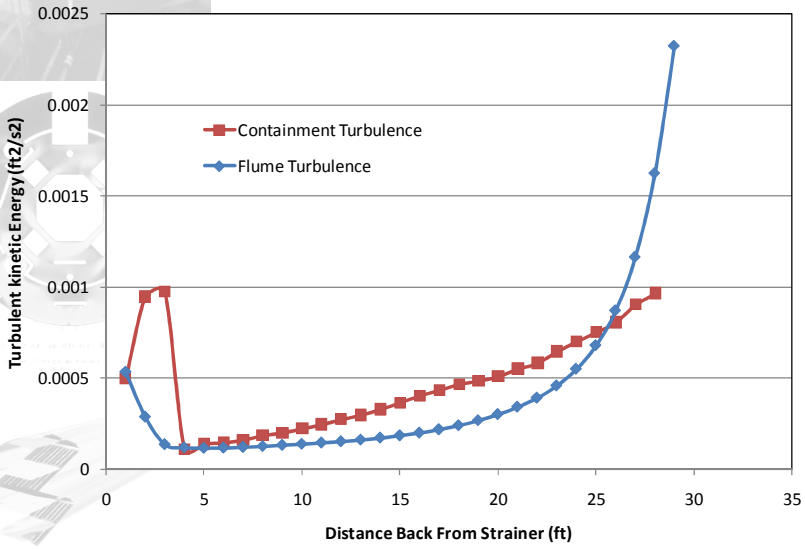


Long-term recirculation TKE (ft^2/s^2)

E15: Turbulence in containment and flume / test configuration

- Debris interceptor, despite its low height blocks most break flow from reaching strainer
- Flume Reynolds numbers are in the turbulent range
- Flume effective turbulence is on par with that calculated in containment
- Turbulence levels calculated in containment correspond to a maximum of 0.02 ft/sec RM





Distance from screen (ft)	Velocity (ft/sec)	Flume Width (in)	Hydraulic Radius (ft)	Reynolds #
1	0.10	10.4	0.39	6704
2	0.10	9.9	0.37	6045
3	0.10	11.3	0.41	6644
6	0.08	14.3	0.51	6435
10	0.09	11.7	0.42	6617
21	0.12	8.9	0.33	6821
25	0.13	8.5	0.32	6852
30	0.13	8.4	0.32	6861

E16: Pool fill transport & distance traveled by debris

- Preferential pool fill transport is limited except during sump C fill-up
- Sump C fill-up preferentially causes debris to move away from strainer bank
- No credit for this transport is taken in the analysis
- The average distance traveled by debris is greater than 30’ when considering calculated zone exit flow splits
- TempMat calculated transport fraction was increased by 20% of debris generated for conservatism in determining test quantity
- Transport testing at Alden showed 3x – 4x approach velocity profile only yielded partial transport of TempMat smalls.