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NUCLEAR ENERGY

CC3 Chapter 9, UHS Update
March 18, 2013

Public Meeting regarding issues related to Ultimate Heat Sink System at Calvert Cliffs Nuclear Power Plant Unit 3

Issues related to Ultimate Heat Sink System

Agenda

- UniStar Response to NRC follow-up questions/comments
  RAIs 325, 330, 332, 333, and 337 — UniStar/Bechtel
- Update and status of UHS cooling tower interference work — UniStar/Bechtel
- Timeline for RCOLA UHS RAI Response Schedule — UniStar

Response to NRC Follow-up Questions RAI 330

- **RAI 330/6212, Question 09.02.05-20**
- **Responses**
  - **Page 8/13** – typo 3.i should be 3.l.
    Typo will be corrected
  - **Page 8/13** ***(Page 9/13)*** **–** typo 9.4.9 should be 2.4.9.
    Typo will be corrected

- **FSAR Markups**
  - **Pages 60/137 and 61/137** – typo AA0007 should be AA005.
    Typo AA0007 will be corrected
  - **Page 62,63,64,65 of 137** – strainer has 2 MOVs.
    There are two motors in the strainer equipment, one to rotate the back wash arm and other for the blowdown valve. Will clarify in the FSAR markup.
  - **Page 74/137-**"valve opens" – consider changing to "auto" opens. Describe the signals to close the screen wash valve.
    Will clarify that valve opens automatically. The valve closes once the water level across the traveling screen is at normal operating level or when the timed sequence is completed. This description will be added.

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Response to NRC Follow-up Questions RAI 330

- **Page 85/137** - consider adding the forebay water level instruments that will be used to verify TS to Table 9.2-2. This table only has delta level instruments. Is there a low water level alarm for the UHS makeup pump basin?
  The UHS Makeup Water Traveling Screen downstream level gauge (CL002) will be used for the UHS Makeup Water Pump Forebay level reading that will be used to verify the Tech Spec pump forebay level is greater than or equal to -11.7 ft. Table 9.2-2 will be revised to include CL002 input as low level alarm.
- **Page 96/137** – what is the material for pump expansion joint?
  Material will be specified in detailed design phase. Material will be compatible with the UHS Makeup Water System water chemistry, such as AL6XN or equivalent.
- **Page 96/137** – check valve missing #.
  Check valve is no longer required and will be removed from this FSAR Figure 9.2-9.
- **Page 96/137** – dP missing #
  The dP number CP002 will be added to the FSAR Figure 9.2-9.
- **Page 106/137 (Chapter 14)** – Item L. consider adding "automatically " to rotated and washed.. Editor note, typo – 14.02-58? Not 14.02-28. Needs corrected.
  Will add "automatically" for Item L. 'Editors Note' was not intended to be provided in the response and will be deleted.
- **Page 136/137** – Table design area "3" – consider deleting since area 3 is not on the drawing.
  Design Area 3 is no longer applicable and will be deleted from ITAAC Figure 2.4-1.

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Response to NRC Follow-up Questions RAI 332

- **RAI 332/6228, Question 09.02.05-22**
- **Responses**
  - **Page 5/8** – 'safety related manual valve and safety related check valve' – should have GDC 2 statement in response
    Will add the GDC 2 statement in the response to the RAI.
  - **Page 5/8** – 'normal makeup' – describe NSR keep fill interactions during testing and accident conditions . Is manual action required to isolate the NSR keep fill?.
    Manual action is not required to close the safety-related isolation valve located on the UHS Makeup Keep-Fill line. A check valve is provided to prevent back flow to the Normal Makeup line during ESW Emergency Makeup Water System testing or accident conditions. Manual isolation valve is provided for any maintenance on the check valve.
  - **Page 5/8** – NSR keep fill – is a pressure gauge needed to verify that NSR keep fill is working correctly?
    Pressure gauge is not required to verify that the Non Safety-Related UHS Makeup Keep Fill-Line is working properly. The UHS Makeup Keep Fill-Line is operational during normal plant operation. During this time the Normal Makeup water system lines are at the higher pressure than the UHS (Emergency) Makeup Water lines for the operating and non-operating trains. However, a level switch with alarm is provided in the UHS (Emergency) Makeup Water piping to indicate unfilled condition of the system.

Response to NRC Follow-up Questions RAI 332

- **RAI 332/6228, Question 09.02.05-22**
  - **Page 5/8 and 6/8- "**has significant margin" (several places); should provide design numbers to support this statement
    The pump design flow data for the Normal Makeup water pumps will be developed during detail design and will account for leakages from the UHS Makeup Water System. ESWS pump and UHS Makeup Water pump flow data is included in the response.
  - **Page 5/8** - 627 gpm vs 648 gpm (FSAR markup page 14)- which is correct?
    The site-specific Normal Makeup Water System provides approximately 648 gpm (2452.68 lpm) to the ESW Basin and UHS Makeup Water System. The response will be corrected.
  - **Page 6/8** – 'system will be completely flushed' – does the system have any dead legs, if so, how are dead legs addressed?
    No dead legs are present in the current conceptual design of the system. Any dead leg (if exists) during the detail design will be provided with low point drain connection to address flushing of the system.
  - **Page 7/8** – 'will be closed' (2 places)- consider adding automatically.
    Word "automatically" will be added.
  - **Page 7/8** – 'level alarm will direct the operator' – EPR DC has levels 1, 2, 3, 4 – which level is the alarm?
    There are no interlocks or permissives for starting the UHS Makeup Water System pumps. Operator action is required to start the pumps manually from the MCR, after the receipt of a safety injection signal, to maintain UHS cooling tower basin water level, per the response to RAI 325. The response to RAI 332 will be revised.

Response to NRC Follow-up Questions RAI 332

- **RAI 332/6228, Question 09.02.05-22**
  FSAR Markups
  - **Page 3/51 and 14/51** – 627 gpm vs. 648 gpm?
    648 gpm is correct and will be incorporated in Section 2.4.11.6 (page 3/51 of markup) and any other relevant place in the COLA FSAR.
  - **Page 9/51** – AA008 – does this need to be added to Table 3.10-1?
    This UHS Makeup Water Bypass valve (AA008) will be added in Table 3.10-1.
  - **Page 16/51** – did not see the SR new keep fill system from ESWS described in FSAR Section 9.2.1 .
    Description of safety-related Post-DBA UHS Makeup Keep-Fill line will be added in COLA FSAR Chapter 9, Subsection 9.2.1.
  - **Page 25/51** – 'full at all times' – provided the keep fill pumps are running – consider clarification.
    Will add "with Normal Makeup Water Pumps running"
  - **Page 25/51** – min. recirculation valves are opened/closed – consider adding 'auto' open, 'auto' close.
    Will add "auto" for the valve opening/closing.
  - **Page 25/51** – effects of water hammer discussion now missing with the new added text. Consider adding this back.
    The UHS Makeup Water System is a wet layup configuration. It is filled with water, tested and ready to operate during normal operation and prior to an accident. One of the advantages of changing the UHS Makeup Water System from dry layup to wet layup configuration is eliminating the water hammer effect during post-accident system start up. With wet layup configuration water hammer is not a concern. A statement to this effect will be added to the COLA FSAR.

Response to NRC Follow-up Questions RAI 332

- **RAI 332/6228, Question 09.02.05-22**
  FSAR Markups
  - **Page 25/51-** SR keep fill – consider describing the ESW interactions during accidents.
    The interaction between the safety-related Post-DBA UHS Makeup Keep-Fill line and the ESW System will be provided in COLA FSAR Chapter 9, Subsection 9.2.5.2.3 as follows:

    During post DBA operation, the UHS Makeup Water System becomes operational and the UHS Makeup Water line becomes pressurized by the makeup water pump. The safety-related check valve installed in the Post-DBA UHS Makeup Keep-Fill line will prevent UHS (emergency) makeup water from flowing to the ESW System. Depending up on the pressure difference between the two systems during post DBA operation, the safety-related check valve may or may not allow ESW water to flow from ESW System to UHS Makeup Water System. There is no loss of water from the ESW System during this operation.
  - **Page 31/51** – dashes for buildings - missing some labels.
    Dashed borderlines for the buildings and missing labels will be incorporated.
  - **Page 31/51** – SR/NSR boundary moved from AA019.
    SR/NSR boundary will be relocated to upstream side of motor operated site-specific NSR Normal Makeup Water System isolation valve AA019.
  - **Page 31/51-** UHS makeup keep fill (gate and check) – in which building are these valves located ?
    The UHS Makeup Water Keep-Fill gate valve and check valve are located inside the ESW pump building. The relative location with the dashed building lines will be adjusted accordingly.

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Response to NRC Follow-up Questions RAI 332

- **RAI 332/6228, Question 09.02.05-22**
  FSAR Markups

  - **Page 31/51** – consider adding pressure gauge to verify keep NSR fill is operating correctly
    Pressure gauge is not required to verify that the Non Safety-Related UHS Makeup Keep Fill-Line is working properly. The UHS Makeup Keep Fill-Line is operational during normal plant operation. During this time the Normal Makeup water system lines are at the higher pressure than the UHS (Emergency) Makeup Water lines for the operating and non-operating trains. However, a level switch with alarm is provided in the UHS (Emergency) Makeup Water piping to indicate unfilled condition of the system.
  - **Page 33/51** – consider adding the ESW keep fill to the FSAR figure.
    ESW Keep fill line (Tower Keep Fill Line) is already shown on this FSAR Figure 9.2-10
  - **Page 51/51** – note 5, "to filling of the UHS tower with saline" vs. "to bypass of the UHS tower with saline." Consider correcting to bypass saline.
    Note 5 of this figure (Part 10 Figure 2.4-3) will be revised as above.

Response to NRC Follow-up Questions RAI 337

- **RAI 337/6235, Question 14.02-58**

- **Responses**
  - **Pages 4, 5 and 7 of 8 -** Item 3 - need Chapter 14 testing/verification that there is no evidence of significant water hammer during system manual startup, manual system testing, or auto keep-fill of the UHS

Based on keeping the UHS Makeup Water System full with the "Keep Fill" systems there is no potential for water hammer effects. However, a verification statement will be added to COLA FSAR Section 14.2.14.2.

Response to NRC Follow-up Questions RAI 325

- **RAI 325/6066, Question 07.05-1**

- **FSAR Markups**
  - **Page 10/17** – consider adding valve #'s in the description for FSAR 9.2.5.3.2, UHS makeup water system isolation valves
    Will add valve numbers for the discharge check valve and motor operated isolation valve.
  - **Page 10/17** – consider adding "automatically" to open or close valves.
    Will add the word "automatically" to the open or close valve description.
  - **Page 13/17** - bottom three lines appear to be out of place and should be deleted.
    These lines will be deleted.

Response to NRC Follow-up Questions RAI 336

- **RAI 336/6230, Question 09.02.05-23**
- **Responses**
  - **Page 4/23** – Part 2, consider adding the forebay water level instruments that will be used to verify TS related to Table 9.2-2. This table only has delta level instruments. Is there a low water level alarm for the UHS makeup pump basin? If yes, include in the description. If not, provide justification.
    The UHS Makeup Water Traveling Screen downstream level gauge (CL002) reading provides the UHS Makeup Water Pump Forebay level. Table 9.2-2 will be revised to include CL002 input as low level alarm and other nearby instruments such as UHS makeup water pump bearing temperature CT001 and CT002.

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Response to NRC Follow-up Questions RAI 333

- **RAI 333/6214, Question 03.08.04-29**
  - What long term "operational" inspection program will be in place for the inspection of the internal mortar piping for the ESWS and UHS piping. This should be addressed in the FSAR.

    The ability to inspect this piping will be designed into the system (e.g., vaults with removable spool pieces or bypass sections), to enable remote video type equipment to be inserted into the line where visual examinations could be performed. Periodic inspection requirements of safety-related piping will be added to an applicable plant inspection program, such as buried pipe or ISI, and will be noted in future FSAR markups.
  - What long term "operational" inspection program will be in place for the inspection of the internal epoxy lined piping for the ESWS piping. This should be addressed in the FSAR.

    See response above.
  - How are repairs made if the 'cement lining' or 'epoxy line' degrades, Describe in the FSAR if the 60" dia. piping can be dewatered for repairs. Are there stop logs at both suction and the pump house?

    Damage found within the fusion bonded epoxy would have to be dug up and replaced. Repairs to internal cement lining are feasible for larger pipe sizes, e.g. 30 or 60 inch, but it would be more practical to replace degraded smaller pipe sizes. Dewatering of 60-inch diameter piping would be required for internal repair, and methods to achieve this dewatered condition are included in the piping design. There will be provisions for stop logs on both ends of the pipe, added during detailed design.

Response to NRC Follow-up Questions RAI 333

- **FSAR Markups**
  - **Page 39/40** – ITAAC missing related to the concrete/mortar and epoxy coatings on the ESW/UHS pipe (inside wall). Also, no ITAAC found for waterproofing and cathodic protection systems.

  – The CCNPP Unit 3 COLA ITAAC Table 2.4-8 (Buried Conduit Duct Banks, and Pipe and Pipe Ducts ITAAC) item 9 Commitment Wording states, "Protective measures for buried Seismic Category I steel/iron pipes include protective waterproof wrapping or coating."

  – There are no ITAAC for the inside wall coatings or cathodic protection systems.

Calvert Cliffs U3 UHS Cooling Tower Recirculation/Interference Analyses Status/Update

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CC3 UHS CT Interference Overview

1) COL Items – Analysis Objectives
2) Overall Analysis Inputs and Acceptance Criteria
3) Parametric Study Using Tracer Particles
4) Preliminary Tracer Particle Results
5) CFD Methodology
6) CFD Preliminary Results
7) Closure Plan

CC3 UHS CT Interference
COL Items – Analysis Objectives

1. Confirm that the increased wet bulb temperature of the intake air for the adjacent Cooling Tower is bounded by the U.S. EPR FSAR allowance for Tower Recirculation and Interference as per COL Item 9.2-7 (RAI 287/365)

"A COL applicant that references the U.S. EPR design certification will confirm that the site characteristic sum of 0% exceedance maximum noncoincident wet bulb temperature and the site-specific wet bulb correction factor does not exceed the value provided in Table 9.2.5-2. If the value in Table 9.2.5-2 is exceeded, the maximum UHS cold-water return temperature of 95° F is to be confirmed by analysis (see Section 9.2.5.3.3)."

2. Determine the effect of the UHS Cooling Tower discharge on the nearby Safety Related HVAC intakes (increased temperature) (COL Item 9.2-10, RAI 331)

"A COL applicant that references the U.S. EPR design certification will perform an evaluation of the interference effects of the UHS cooling tower on nearby safety-related air intakes. This evaluation will confirm that potential UHS cooling tower interference effects on the safety related air intakes does not result in air intake inlet conditions that exceed the U.S. EPR Site Design Parameters for Air Temperature as specified in Table 2.1-1."

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CC3 UHS CT Interference

Overall Analysis Inputs and Acceptance Criteria

The maximum allowance for the Cooling Tower recirculation and interference is determined based on:

- Large Break (LB) LOCA Heat Load
- Loss of Offsite Power with Diesel Failure – two Cooling Towers operating
- Maximum 24-hour wet bulb hourly temperature for minimum cooling (consistent with US EPR Table 9.2.5-4)
- Cooling Tower interference allowance (maximum site specific wet bulb correction factor) determined by increasing 24-hour wet bulb hourly temperatures until the maximum allowed ESW supply temperature is reached (95°F). Analysis value of this allowance is 2.5°F.
- HVAC interference allowance determined by increasing site maximum dry bulb temperature (0% and 1% exceedence) to FSAR Table 2.1-1 values. Value of this allowance is 7°F.

CC3 UHS CT Interference
Parametric Study Using Tracer Particles

- Objective: identify limiting scenarios to establish inputs for further study using computational fluid dynamics.
- No credit for buoyancy, so interference is amplified.
- Wind speed from 1 m/s to 10 m/s is considered based on review of 30-year meteorological data.
  - Calm wind conditions not associated with high temperatures of concern.
  - Wind speed above 10 m/s and sustained not associated with high temperatures of concern.
- All combinations of UHS cooling towers (taken two at a time) considered.
- Wind direction from all compass points (22.5° apart) considered for each of six cooling tower configurations (A thru F) – total of 96 scenarios.

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CC3 UHS CT Interference
Parametric Study Using Tracer Particles (Cont.)

- Calculate approximate ingestion temperatures for wind speed 5 m/s for all scenarios and target scenarios with greater than 2.5°F interference.
- Perform sensitivity studies on wind speeds to identify worst speed for targeted scenarios.
- Select cases with highest ingestion temperatures for CFD analysis.

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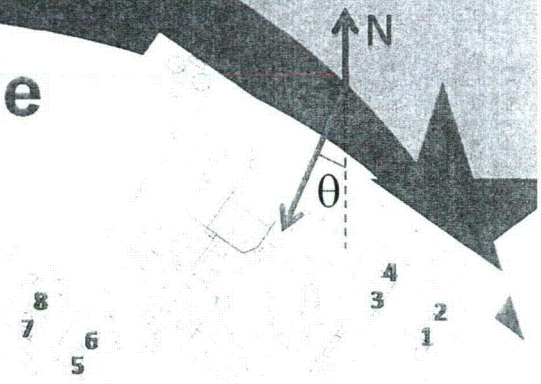
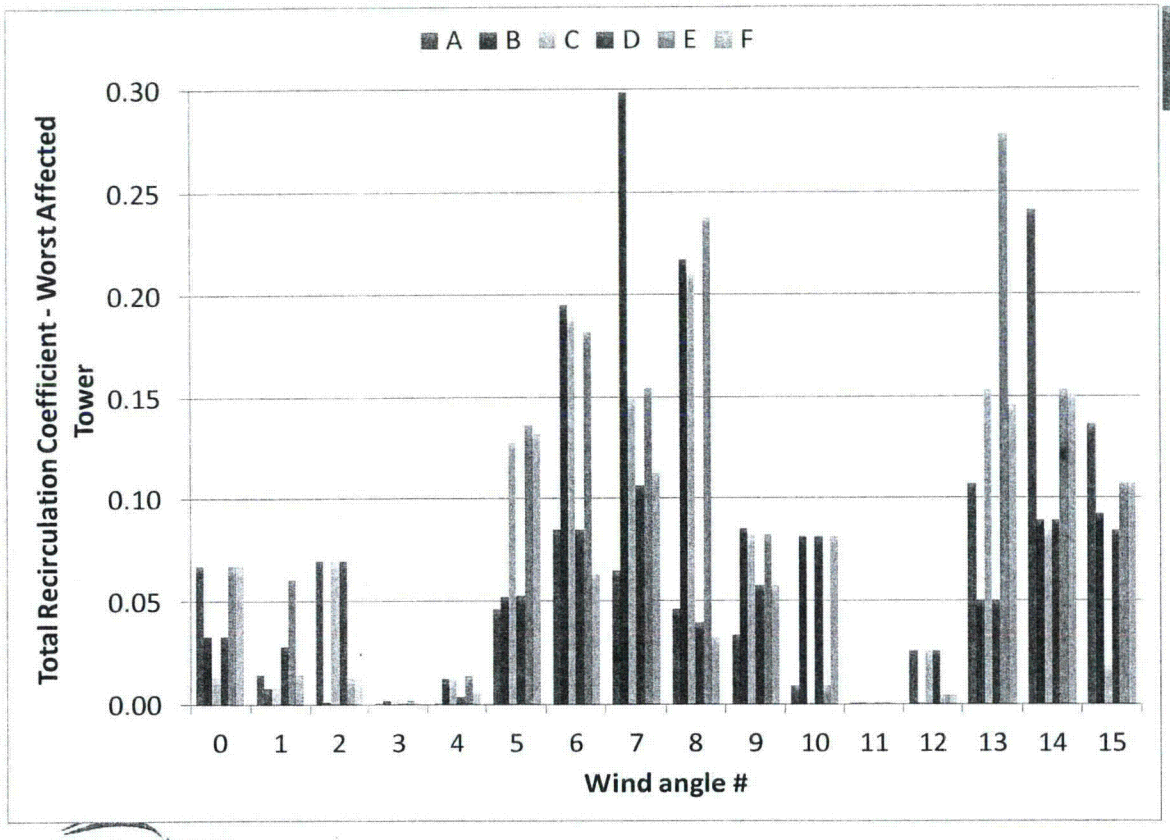
Preliminary Tracer Particle Results





#	Wind angle
0	0.0
1	22.5
2	45.0
3	67.5
4	90.0
5	112.5
6	135.0
7	157.5
8	180.0
9	202.5
10	225.0
11	247.5
12	270.0
13	292.5
14	315.0
15	337.5

Operating Scenarios with two towers in operation(2 cells in each tower)

Scenario	Operating Cells
A	1-2-3-4
B	5-6-7-8
C	1-2-5-6
D	1-2-7-8
E	3-4-5-6
F	3-4-7-8

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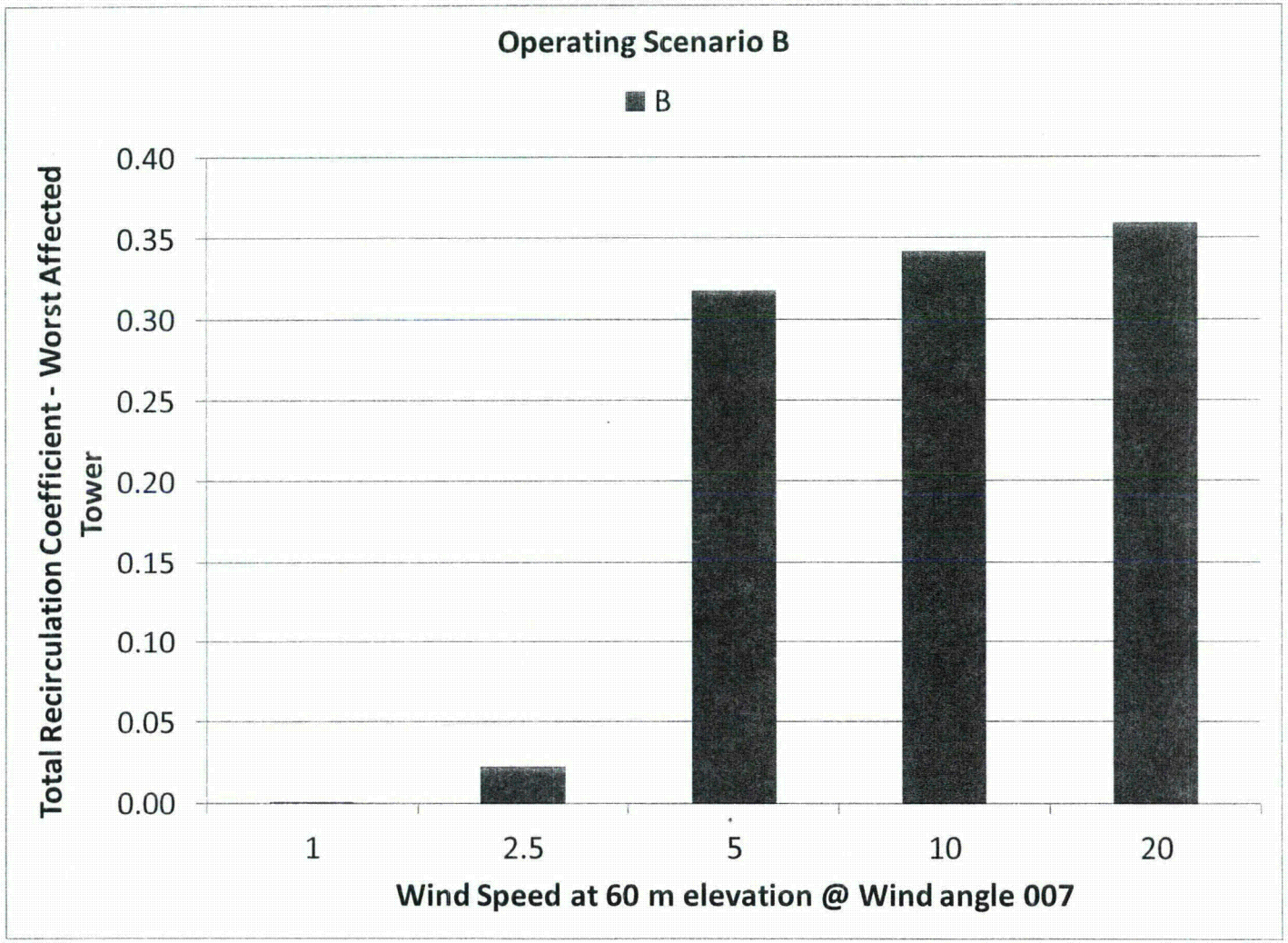
Preliminary Tracer Particle Results



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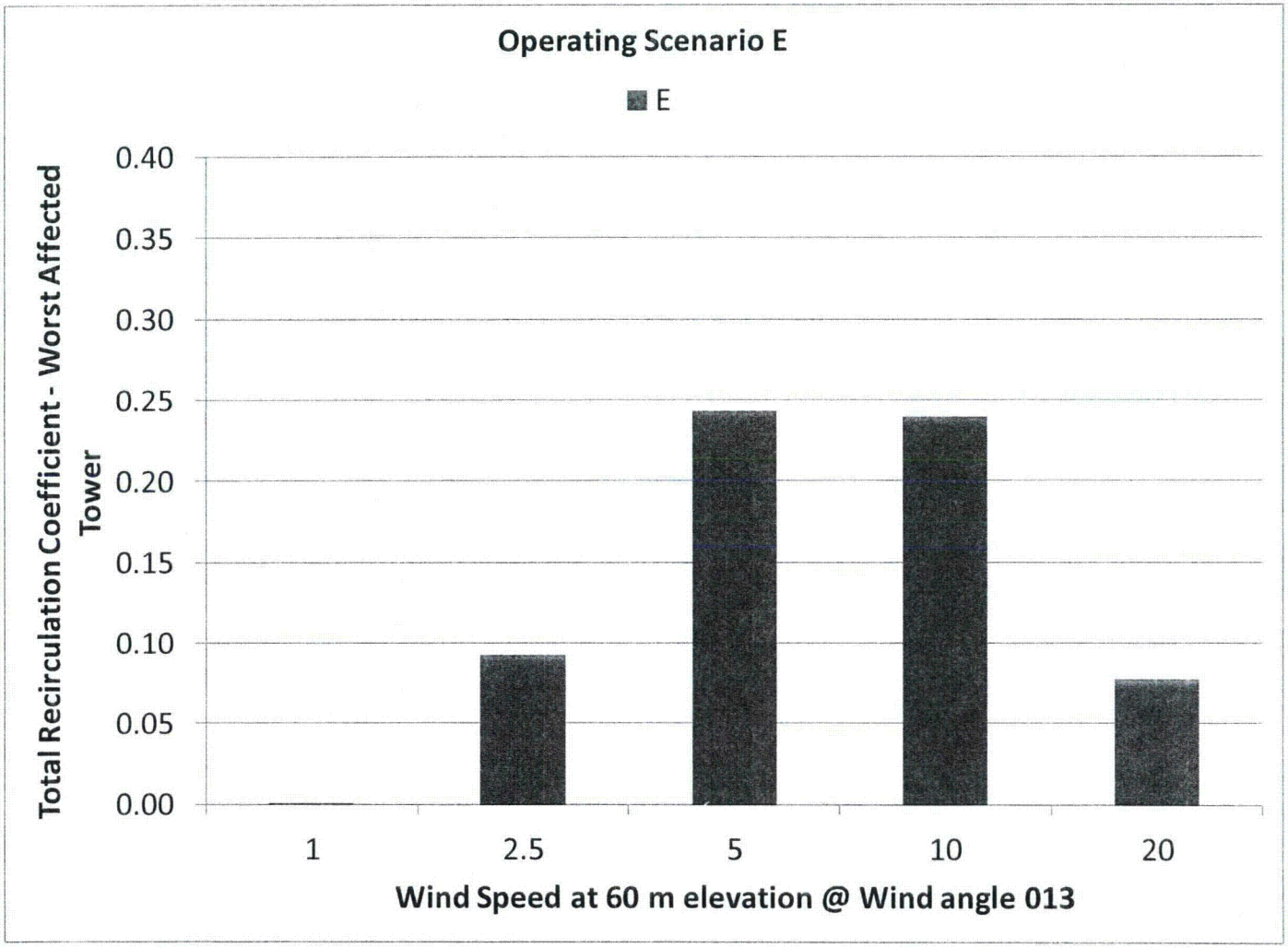
Preliminary Tracer Particle Results



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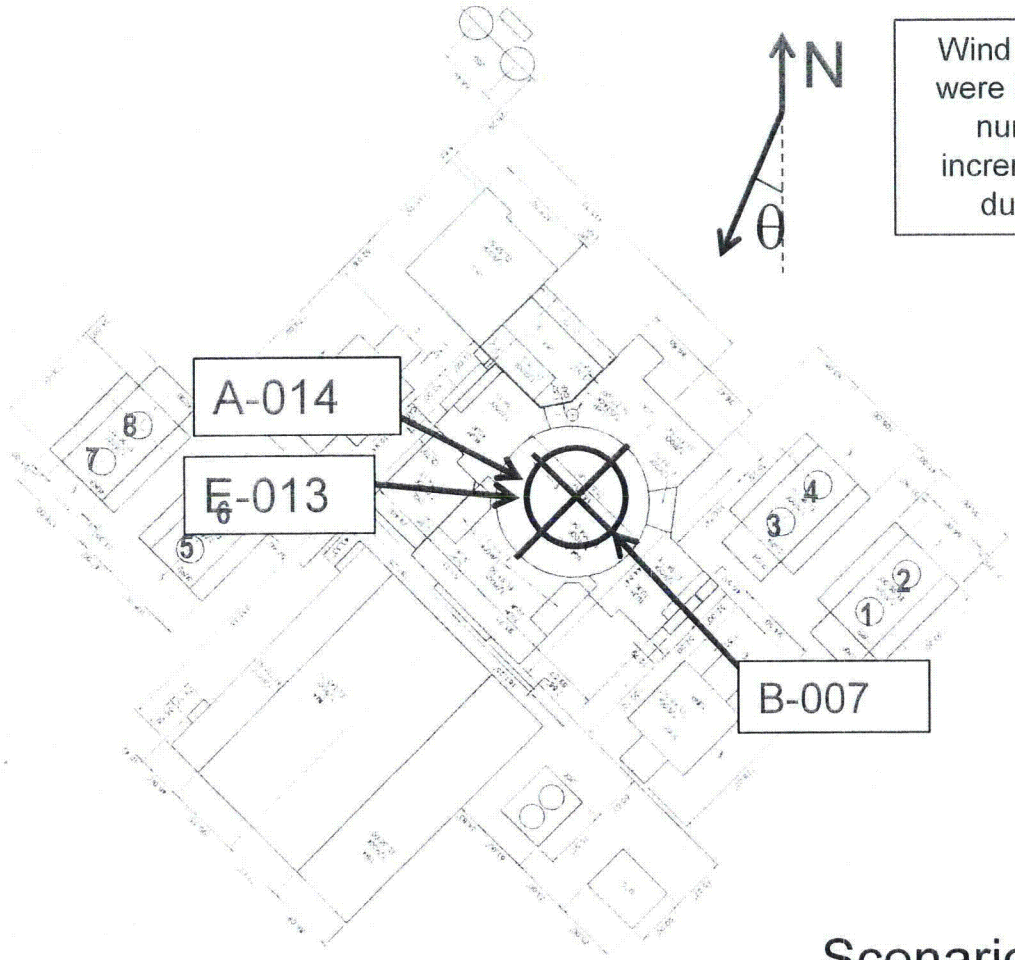
Preliminary Tracer Particle Results



Wind directions were labeled by numbered increment from due north

Scenario	Operating Cells
A	1-2-3-4
B	5-6-7-8
C	1-2-5-6
D	1-2-7-8
E	3-4-5-6
F	3-4-7-8

Scenarios B-007, E-013 and A-014 selected for CFD

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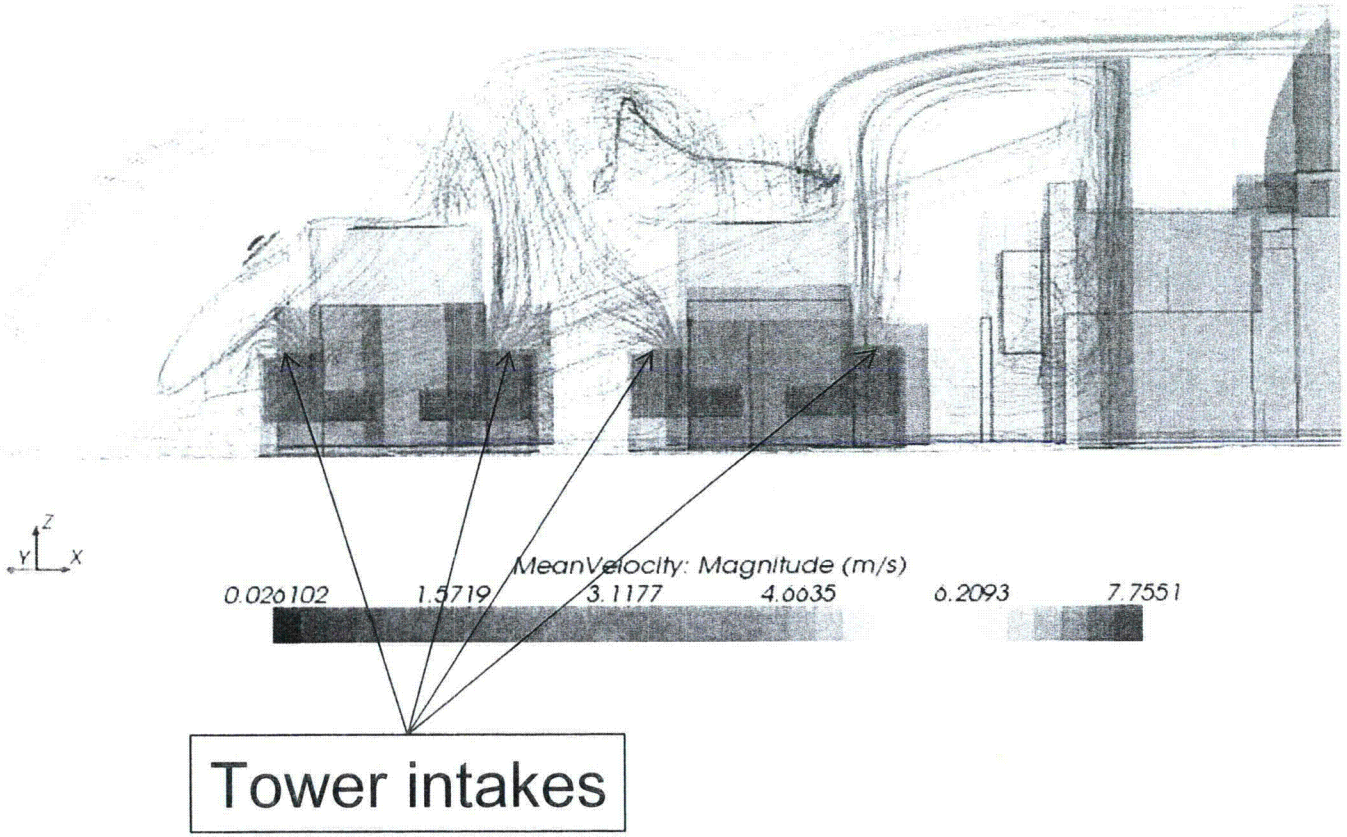
Preliminary Tracer Particle Results
B-007 @ 10 m/s



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CFD Methodology for Calculating Recirculation and Interference

1. Model Inputs – ambient wet bulb temperature, relative humidity, heat load.
2. Cooling tower fan ACFM is assumed constant and discharge is assumed 100% saturated (applied at the outflow boundary).
3. Jet/Plume non-dimensional numbers and transition length scales, are calculated based on discharge and ambient conditions.
4. Based on research findings, only two layers of buildings need to be included when a fully developed atmospheric boundary layer is input into the model.
5. Calculate the effects of recirculation of the added heat on the cooling tower outflow using a cooling tower performance model.
6. Rerun the CFD model with the new cooling tower outflow conditions.
7. Repeat steps 3 to 6 until the difference between wet bulb temperature at the intakes from the ambient wet bulb temperature does not change.
8. Report the final wet bulb ΔT for that specific operating and boundary condition scenario.

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CFD Preliminary Results

Wind Speed	Operating Scenario	Wet Bulb increase at the intake for the more affected tower
5 m/s *	B 007	0.91° F
5 m/s	E 013	1.49° F
5 m/s	A 014	0.46° F
10 m/s *	B 007	2.3° F

*A fourth scenario was chosen to include a higher wind speed that was shown to cause greater ingestion for only case B.

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CC3 UHS CT Interference Closure Plan

- Complete V&V and dedication of Star-CCM+ software.
- Finalize calculation documentation.
- Provide response to RAIs 287, 331 and 365.
- Current schedule will complete by April 30, 2013
- Audit?

Questions?

CC3 FSAR Chapter 9 Overall Schedule

- Provide outstanding Chapter 9 RAI responses by April 30, 2013
- ACRS schedule?

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NRC/UniStar
Calvert Cliffs Unit 3
Public Meeting – March 18, 2013
Staff's Feedback
on the
Ultimate Heat Sink RAI Responses
(FSAR Section 9.2.5)

UHS FSAR Section 9.2.5
RAI Responses and Open Discussions

U.S.NRC
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RAI 332/6228, Question 09.02.05-22

- **General Comments**
  - **Overall** – favorable response
- **Responses**
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UHS FSAR Section 9.2.5
RAI Responses and Open Discussions

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UHS FSAR Section 9.2.5
RAI Responses and Open Discussions

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  - **Page 31/51** – consider adding pressure gauge to verify keep NSR fill is operating correctly
  - **Page 33/51** – consider adding the ESW keep fill to the FSAR figure.
  - **Page 51/51** – note 5, "to filling of the UHS tower with saline" vs. "to bypass of the UHS tower with saline" Consider correcting to bypass saline.

UHS FSAR Section 9.2.5
RAI Responses and Open Discussions

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UHS FSAR Section 9.2.5
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  - **Page 106-137 (Chapter 14)** – Item L. consider adding "automatically " to rotated and washed.. Editor note, typo – 14.02-58? Not 14.02-28. Needs corrected.
  - **Page 136/137** – Table design area "3" – consider deleting since area 3 is not on the drawing. .

UHS FSAR Section 9.2.5
RAI Responses and Open Discussions

U.S.NRC
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RAI 337/6235, Question 14.02-58

- **General Comments**
  - **Overall – favorable response**
- **Responses**
  - **Pages 4, 5 and 7 of 8 -** Item 3 - need Chapter 14 testing/verification that there is no evidence of significant water hammer during system manual startup, manual system testing, or auto keep-fill of the UHS

UHS FSAR Section 9.2.5
RAI Responses and Open Discussions

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United States Nuclear Regulatory Commission
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RAI 333/6214, Question 03.08.04-29

•General Comments

- **•Overall** – favorable response related to Section 9.2.5
- •What long term "operational" inspection program will be in place for the inspection of the internal mortar piping for the ESWS and UHS piping. This should be addressed in the FSAR.
- •What long term "operational" inspection program will be in place for the inspection of the internal epoxy lined piping for the ESWS piping. This should be addressed in the FSAR.
- •How are repairs made if the 'cement lining' or 'epoxy line' degrades, Describe in the FSAR if the 60" dia. piping can be dewatered for repairs. Are there stop logs at both suction and the pump house?

•FSAR Markups

- **•Page 39/40** – ITAAC missing related to the concrete/mortar and epoxy coatings on the ESW/UHS pipe (inside wall). Also, no ITAAC found for waterproofing and cathodic protection systems.

UHS FSAR Section 9.2.5
RAI Responses and Open Discussions

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RAI 325/6066, Question 07.05-1

- **General Comments**
  - **Overall** – favorable response
- **FSAR Markups**
  - **Page 10/17** – consider adding valve #'s in the description for FSAR 9.2.5.3.2, UHS makeup water system isolation valves
  - **Page 10/17** – consider adding "automatically" to open or close valves.
  - **Page 13/17 -** bottom three lines appear to be out of place and should be deleted.