PROPOSED TECHNICAL SPECIFICATION CHANGES

4.5.2 Reactor Building Cooling Systems

Applicability

Applies to testing of the reactor building emergency cooling systems.

Objective

To verify that the reactor building emergency cooling systems are operable.

Specification

4.5.2.1 System Tests

4.5.2.1.1 Reactor Building Spray System

(a) Once every 18 months, a system test shall be conducted to demonstrate proper operation of the system. A test signal will be applied to demonstrate actuation of the reactor building spray system (except for reactor building inlet valves to prevent water entering nozzles).

(b) Station compressed air or smoke will be introduced into the spray headers to verify the availability of the headers and spray nozzles at least every five years.

(c) The test will be considered satisfactory if visual observation and control board indication verifies that all components have responded to the actuation signal properly.

4.5.2.1.2 Reactor Building Cooling System

(a) At least once per 14 days, each reactor building emergency cooling train shall be tested to demonstrate proper operation of the system. The test shall be performed in accordance with the procedure summarized below:

(1) Verifying a service water flow rate of ≥ 800 gpm to each train of the reactor building emergency cooling.

(2) Addition of a biocide to the service water during the surveillance in 4.5.2.1.2.a.1 above, whenever service water temperature is between 60F and 80F.

(b) At least once per 31 days, each reactor building emergency cooling train shall be tested to demonstrate proper operation of the system. The test shall be performed in accordance with the procedure summarized below:

(1) Starting (unless already operating) each operational cooling fan from the control room.

The verification of service water flow rate to each train of reactor building emergency cooling is performed to ensure that sufficient post-accident reactor building heat load can be removed by the coolers. The flowrate specified in the surveillance requirement corresponds to the conservative configuration of two fans and their associated cooling coils for each train of reactor building emergency cooling. The minimum flow rate which corresponds to the post-accident heat removal capability for other system configurations may be justified consistent with the bases of Specification 3.3.4(a).

Addition of a biocide to service water is performed during reactor building emergency cooler surveillance to prevent buildup of Asian clams in the coolers when service water is pumped through the cooling coils. This is performed when service water temperature is between 60F and 80F since in this water temperature range Asian clams can spawn and produce larva which could pass through service water system strainers.

The delivery capability of one reactor building spray pump at a time can be tested by opening the valve in the line from the borated water storage tank, opening the corresponding valve in the test line, and starting the corresponding pump. Pump discharge pressure and flow indication demonstrate performance.

With the pumps shut down and the borated water storage tank outlet closed, the reactor building spray injection valves can each be opened and closed by operator action. With the reactor building spray inlet valves closed, low pressure air or smoke can be blown through the test connections of the reactor building spray nozzles to demonstrate that the flow paths are open.

The equipment, piping, valves, and instrumentation of the reactor building emergency cooling system are arranged so that they can be visually inspected. The cooling fans and coils and associated piping are located outside the secondary concrete shield. Personnel can enter the reactor building during power operations to inspect and maintain this equipment. The service water piping and valves outside the reactor building are inspectable at all times. Operational tests and inspections will be performed prior to initial startup.

Two service water pumps are normally operating. At least once per month operation of one pump is shifted to the third pump, so testing will be unnecessary.

As the reactor building fans are normally operating, starting for testing is unnecessary for those verified to be operating.

Reference

FSAR, Section 6

MARKUP OF CURRENT ANO-1 TECHNICAL SPECIFICATIONS

(FOR INFO ONLY)

4.5.2 Reactor Building Cooling Systems

Applicability

Applies to testing of the reactor building emergency cooling systems.

Objective

To verify that the reactor building emergency cooling systems are operable.

Specification

4.5.2.1 System Tests

4.5.2.1.1 Reactor Building Spray System

(a) Once every 18 months, a system test shall be conducted to demonstrate proper operation of the system. A test signal will be applied to demonstrate actuation of the reactor building spray system (except for reactor building inlet valves to prevent water entering nozzles).

(b) Station compressed air or smoke will be introduced into the spray headers to verify the availability of the headers and spray nozzles at least every five years.

(c) The test will be considered satisfactory if visual observation and control board indication verifies that all components have responded to the actuation signal properly.

4.5.2.1.2 Reactor Building Cooling System

(a) At least once per 14 days, each reactor building emergency cooling train shall be tested to demonstrate proper operation of the system. The test shall be performed in accordance with the procedure summarized below:

   (1) Verifying a service water flow rate of ≥ 800~~1200~~ gpm to each train of the reactor building emergency cooling.

   (2) Addition of a biocide to the service water during the surveillance in 4.5.2.1.2.a.1 above, whenever service water temperature is between 60F and 80F.

(b) At least once per 31 days, each reactor building emergency cooling train shall be tested to demonstrate proper operation of the system. The test shall be performed in accordance with the procedure summarized below:

   (1) Starting (unless already operating) each operational cooling fan from the control room.

The verification of service water flow rate to each train of reactor building emergency cooling is performed to ensure that sufficient post-accident reactor building heat load can be removed by the coolers. The flowrate specified in the surveillance requirement corresponds to the conservative configuration of two fans and their associated cooling coils for each train of reactor building emergency cooling. The minimum flow rate which corresponds to the post-accident heat removal capability for other system configurations may be justified consistent with the bases of Specification 3.3.4(a).

Addition of a biocide to service water is performed during reactor building emergency cooler surveillance to prevent buildup of Asian clams in the coolers when service water is pumped through the cooling coils. This is performed when service water temperature is between 60F and 80F since in this water temperature range Asian clams can spawn and produce larva which could pass through service water system strainers.

The delivery capability of one reactor building spray pump at a time can be tested by opening the valve in the line from the borated water storage tank, opening the corresponding valve in the test line, and starting the corresponding pump. Pump discharge pressure and flow indication demonstrate performance.

With the pumps shut down and the borated water storage tank outlet closed, the reactor building spray injection valves can each be opened and closed by operator action. With the reactor building spray inlet valves closed, low pressure air or smoke can be blown through the test connections of the reactor building spray nozzles to demonstrate that the flow paths are open.

The equipment, piping, valves, and instrumentation of the reactor building emergency cooling system are arranged so that they can be visually inspected. The cooling fans and coils and associated piping are located outside the secondary concrete shield. Personnel can enter the reactor building during power operations to inspect and maintain this equipment. The service water piping and valves outside the reactor building are inspectable at all times. Operational tests and inspections will be performed prior to initial startup.

Two service water pumps are normally operating. At least once per month operation of one pump is shifted to the third pump, so testing will be unnecessary.

As the reactor building fans are normally operating, starting for testing is unnecessary for those verified to be operating.

Reference

FSAR, Section 6

ARKANSAS NUCLEAR ONE
CALCULATION COVER SHEET

Calc. No.: 95-E-0046-03 **Rev. No.:** 0

Calc. Title: RB Cooler Minimum Service Water Flow Requirements.

Unit: 1 **Category:** Q
System (s): RBHV, SW
Calc. Type: MG

Component No (s): VCC-2A, 2B, 2C, 2D.

Topic (s): ENVQ, ECCS, CTPT, LOOP, LOCA, DBAA
Plt Area: **Bldg.** 1RB **Elev.** 374 ft-6 in
Room ______ **Wall** ______
Coordinates: ______

Config. Checklist (per 5010.004) completed? (Y or N) Y

Abstract (Included Purpose/Results): Purpose of this calculation is to provide design basis for minimum service water flow to the two parallel RB Coolers in each train (normal alignment).

Result: A total minimum flow of 800 gpm is required for each train of RB Coolers.

Pages Revised and/or Added: All new pages 1-5, Attachment 1, pages 1- 12, Attachment 2, pages 1-2

Purpose of Revision: New issue

Initiating Documents	Resulting Document(s)	Key Design Input Docs.
CR-1-95-0433 TM 95-1-025	N/A	Calc. 88-E-0098-16, rev 0 Calc. 88-E-0098-17, rev 0 Calc. 95-E-0046-01, rev 0

Verification Method: **Design Review** X **Alternate Calculation** ______ **Qualification Testing** ______

Amends Calc(s): 88-E-0098-16, rev 0

Supersedes Calc(s): N/A

Computer Software Used: Holtec AIRCOOL, ver. 5.02g

By: Roger Wilson / RDW / 5/18/95 **Rvw'd:** ______ / ______ / ______

Chk'd: David MacPhee / DM / 5/18/95 **Apv'd:** Milton Huff / DMH / 5/19/95
(Print Name) (Initials) (Date) (Print Name) (Initials) (Date)

Check if Additional Revisions: ______

Purpose:

The purpose of this calculation is to provide the basis for the minimum SW flow to each train of reactor building service water cooling coils under a normal system configuration in support of a May, 1995 proposed amendment to Technical Specification 4.5.2:

Methodology:

a) Part A will determine the thermal performance of parallel RB coolers and associated fans for flow rates assuming a 50/50 flow split between the coolers. The resulting table will be used to document train operability at 95 °F inlet SW temperature.

b) Part B provides a sensitivity study using a conservative result from Part A for flow imbalances other than 50/50 between the two coolers.

References:

1. Calculation 88-E-0098-16, rev. 0
2. Calculation 88-E-0098-17, rev. 0
3. Calculation 95-E-0046-01, rev. 0 Holtec AIRCOOL runs for "C" RB Cooler
4. Calculation 95-E-0046-01, rev. 0 RB Cooler flow data
5. RB cooler fan test, Job Order 922118, Task 018130
6. PEAR 95-0148 response
7. Holtec AIRCOOL runs (attachment 1)
8. RB Flow resistance curves (attach. 2)
9. Ops Proc. 1104.033, rev. 52, pc-1 & pc-2

Assumptions and Given Conditions

1. Cooler design air flow is 30,000 cfm. Cooler air flow rate is conservatively taken as 27,378 acfm based upon the latest air test for "C" unit (ref. 4) which tested at the lower flow rate on the airside of the four RB coolers. This is a conservative assumption since the data was taken with flow through the normal inlet ductwork and the bypass damper closed. During accident conditions, the bypass damper will open, eliminating the inlet ductwork friction loss. Previous testing with the damper open resulted in air flows in excess of 30,000 cfm for all four coolers (ref. 5). This assumption provides some design margin.

2. Holtec AIRCOOL will be used to model thermal performance, with corrections to match AAF performance data, as described below.

3. The AAF design fouling factor of 0.002 is used (ref. 1).

4. The required heat transfer is taken as 105% of 53.7 million btu/hr. This represents a 5% margin above the heat removal rate assumed in the design basis accident (the

By: ROW	Chk'd: [initials]	Apvd: [initials]

COPATTA analysis, ref. 2). Entering air is input at 286 °F, 74 psia and 100% relative humidity (ref. 2).

5. Thermal performance of VCC-2A, 2B, and 2D is the same as VCC-2C.

Part A:

The COPATTA analysis (ref. 2) is based upon heat transfer input from ref. 1, which in turn is based upon performance data generated using American Air Filter (AAF) computer programs. Because of certain differences in modeling, the Holtec AIRCOOL program slightly over predicts cooler performance. To benchmark Holtec results against AAF results, benchmark cases were run (ref. 3) to determine correction factors for other AIRCOOL generated performance data.

American Air Filter determined performance data for two cases of interest, SW flow at 600 and 1200 gpm with inlet SW temperature of 95 °F (ref. 1). Heat transfer rates for both of these cases were determined. Using the same input data, the Holtec program AIRCOOL was used to determine predicted heat transfer rates, which were expected to be higher. Results at these two conditions were used to determine corrections factors, which will be used to correct the predicted Holtec results to AAF results (ref. 3).

Three Holtec analyses are run using 95 °F SW inlet temperature and flow rates that result in heat removal rates equal to or greater than 56.5 million btu/hr.

Part A Calculation:

The AAF input data are as follows (ref. 1):

Table 1

Total CFM at inlet:	30,000	cfm
Inlet air temperature:	286	deg F
Inlet air pressure:	74	psia
Inlet RH:	100	%
Inlet water temperature:	95	deg F
Case 1 water flow:	1200	gpm
Case 2 water flow:	600	gpm
Case 1 heat transfer:	56,526,685	btu/hr
Case 2 heat transfer:	39,601,139	btu/hr

The predicted heat transfer using AIRCOOL is as follows (ref. 3)

Table 2

Case:	AIRCOOL	Ratio
600 gpm:	40,145,000	0.99

By: EAU	Chk'd: [signature]	Apvd: DMH

The input data to use in the AIRCOOL runs is as follows for all cases:

Table 3

Total CFM at inlet:	27,378	cfm
Inlet air temperature:	286	deg F
Inlet air pressure:	74	psia
Inlet RH:	100	%

For SW flow rates of 750, 800 and 850 gpm at 95 °F inlet SW temperature, the results are (attachment 1):

Table 4

SW Flow			Heat Removal				
(gpm)	50%	50%	AIRCOOL		Corrected (.99)		
total	cooler 1	cooler 2	cooler 1	cooler 2	cooler 1	cooler 2	total
750	375	375	28776000	28776000	28488240	28203358	56691598
800	400	400	30216000	30216000	29913840	29913840	59827680
850	425	425	31604000	31604000	31287960	31287960	62575920

The corrected heat removal for all three cases exceeds 56.5 million btu/hr. Using 800 gpm in Part B is therefore conservative and provides margin to be applied for the flow split analysis.

Part B:

Part A determined that 800 gpm at 95 °F inlet SW temperature exceeds a conservative heat removal of 56.5 million btu/hr. Part B will split the flow between the parallel RB coolers in 10% increments to determine heat removal capability at other than a 50/50 flow split.

Part B Calculation:

Using the 800 gpm, 95 °F inlet SW temperature from Part A, the sensitivity study results are (attachment 1):

Table 5

				Heat Removal (Btu/hr)				
Flow Imbalance	% Flow Imbalance	Flow (gpm)		AIRCOOL		Corrected		
		Clr 1	Clr 2	Cooler 1	Cooler 2	Cooler 1	Cooler 2	Total
50/50	0%	400	400	30216000	30216000	29913840	29913840	59827680
60/40	20%	480	320	34543000	25478000	34197570	25223220	59420790
70/30	40%	560	240	38315000	19716000	37931850	19518840	57450690
80/20	60%	640	160	41759000	12964000	41132615	12834360	53966975

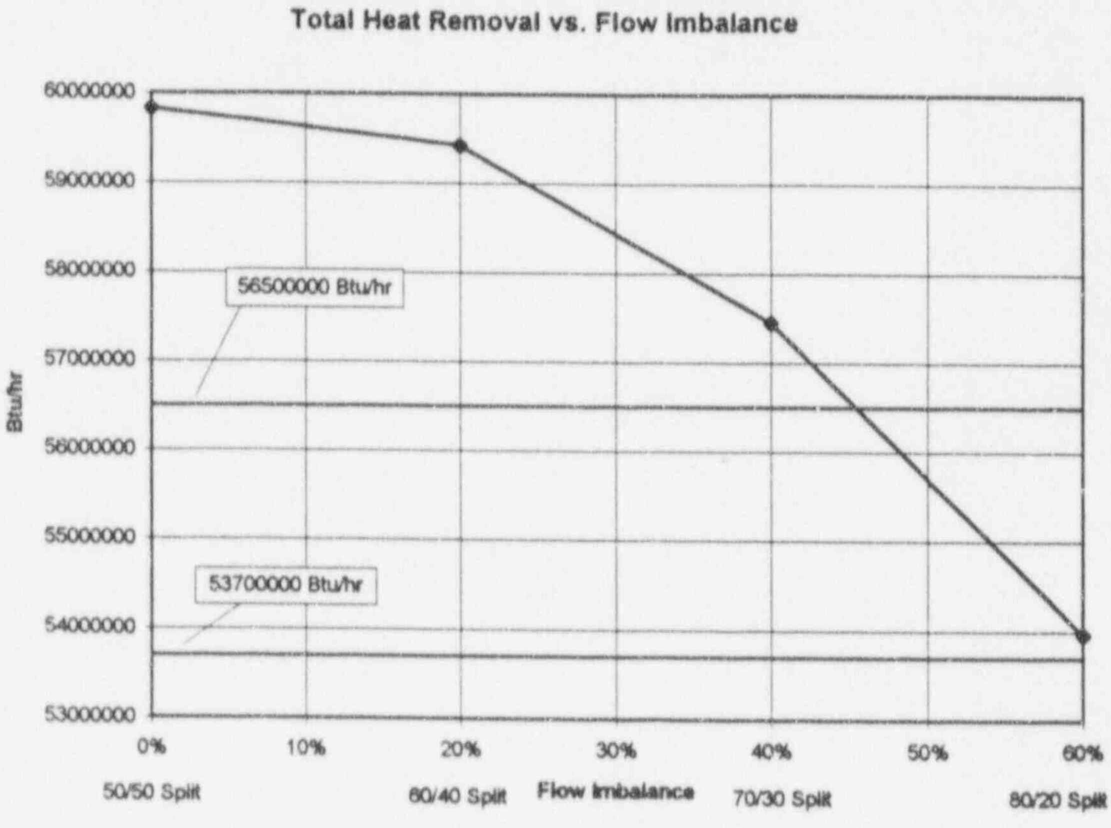


Figure 1

Discussion

Part A of the calculation demonstrates that, with an inlet SW temperature of 95 °F, flow rates of 750, 800 and 850 gpm provide heat removal capability in excess of 105% of design basis accident requirements.

By: RAW	Chk'd: [signature]	Apvd: [signature]

Part B shows that 105% of design accident heat removal is met with a flow imbalance between the coolers where greater than 70% of the total flow is through one cooler and less than 30% total flow is through the parallel cooler.

The coolers are the same size, at the same elevation and were designed for a 50/50 flow split. Attachment 2 demonstrates that this is the case.

Attachment 2 shows that the limits for the operability of the RB coolers will be reached well before a 70/30 flow split is reached. The curves in the attachment are based on the formula $\Delta P = K^* Q^2$ or the resistance factor, K, equals $\Delta P/Q^2$.

Baseline and acceptance resistance factors K_B and K_A were determined from flow data taken during the last refueling outage (1R12) (ref. 9) when the service water system was in its Engineered Safeguards line-up. K_B represents the baseline actual system resistance through parallel RB coolers and piping. K_A represents the operability limit resistance factor for two parallel coolers. The third resistance factor, K_P, was determined from recent testing with flow through one cooler completely blocked by a blind flange (ref. 6).

From examination of the three resistance curves, the large difference between the one and two cooler baseline curves indicates that the assumption of a 50/50 flow split is valid.

Conclusion

A calculated flow rate of 800 gpm provides ample margin for design accident heat removal and includes allowance for flow imbalances between the parallel coolers that far exceed expected flow imbalances.

By: EDW	Chk'd: (m)	Apvd: DZ

PROGRAM AIRCOOL - REVISION 5.02G

FINNED COIL HEAT EXCHANGER RATING PROGRAM

This computer code is QA validated under Holtec International's QA system.

This report was created on: 5/18/1995 at 16:10: 1.24

DOCUMENT TYPE & NO.	95-E-0046-02, Rev 0
ATTACH. 1	PAGE 1 OF 12

Mode of Operation: PERFORMANCE PREDICTION
Name of Data File: C:VCC2C .PPI
File Description:

Component Identification: VCC2C
Component Description:

***** EQUIPMENT CONFIGURATION *****

Parameter	Value	QA Ref #
Number of HX coil sections in parallel per unit	4	1
Number of tube rows crossed by air flow per coil	10	2
Length of finned tube exposed to air flow, in	102.000	1
Number of tubes per row	16	1
Tube outside diameter, in	.6250	1
Tube wall thickness, in	.0490	1
Tube material (1-90/10 CuNi; 2-Copper)	1	1
Tube spacing transverse to air flow, in	1.5000	3
Tube spacing in line with air flow, in	1.5000	3
Fin thickness, in	.0100	1
Fin material (2 - Copper ; 3 - Aluminum)	2	4
Number of fins per inch	6.0	1
Serpentine (0-half; 1-single; 2-double)	2	1
Number of coil groups per unit	2	5
Number of tube rows in group 1	12	5
Number of tube rows in group 2	8	5

Note: The input for number of tube rows crossed by air flow per coil was not used.

Fin style	AAF CORRUGATED PLATE	1

DOCUMENT TYPE & NO.	95-E-0049-03 [illegible]
ATTACH. 1	PAGE [illegible] OF [illegible]

Mode of Operation: PERFORMANCE PREDICTION
Name of Data File: C:VCC2C .PPI
File Description:

Component Identification: VCC2C
Component Description:

QA REF SOURCE DESCRIPTION

01 M61A-7-4, American Air Filter Drawing
M61A-8-4, American Air Filter Drawing
02 Estimated by average of number of tube rows in all eight coils

03 Estimated as 1.5 inch pitch, which is typical of American Air Filter coils of this general geometry
04 Fin material should be CuNi. Copper was used instead since CuNi was not available in this program.
05 DRAWING 6600-M61A-3-4

Mode of Operation: PERFORMANCE PREDICTION
Name of Data File: C:VCC2C .PPI
File Description:

Component Identification: VCC2C
Component Description:

***** PERFORMANCE DATA *****

Procedure # BLIND FLANGE Date: 05/19/95

	Cooling Water	Hot Air	
Pressure	Not required	74.00	psia
Rel humidity in	Not applicable	100.00	%
Rel humidity out	Not applicable	100.00	%
Flow rate in	640.00 gpm	27378.00	acfm
Temperature in	95.00 deg F	286.00	deg F (db)
Temperature out	225.26 deg F	281.25	deg F (db)
Fouling 1/(Btu/Hr/SqFt/degF)	.0020	.0000	
Pressure Drop (clean)	6.03 psi	Not calculated	
Pressure Drop (fouled)	6.03 psi	Not calculated	
Velocity (clean)	3.38 ft/sec	402.62	ft/min

Thermal conductivity of fouling layer, Btu/hr/ft^2/deg F .00

Number of equi-distant air zones along the tube length = 1

Uniform distribution

Heat duty 1000 Btu/Hr (Total/Sensible/Latent) 41759/ 308/ 41450
Avg overall ht coef. (Btu/Hr/SqFt/deg F) 17.18
Gross ht surface area (Sq Ft) 5663
Dew Point temperature, deg F 286.00

Mode of Operation: PERFORMANCE PREDICTION
Name of Data File: C:VCC2C .PPI
File Description:

Component Identification: VCC2C
Component Description:

***** PERFORMANCE DATA *****

Procedure # BLIND FLANGE Date: 05/19/95

	Cooling Water	Hot Air	
Pressure	Not required	74.00	psia
Rel humidity in	Not applicable	100.00	%
Rel humidity out	Not applicable	100.00	%
Flow rate in	560.00 gpm	27378.00	acfm
Temperature in	95.00 deg F	286.00	deg F (db)
Temperature out	231.53 deg F	281.72	deg F (db)

Fouling 1/(Btu/Hr/SqFt/degF)	.0020	.0000	
Pressure Drop (clean)	4.71 psi	Not calculated	
Pressure Drop (fouled)	4.71 psi	Not calculated	
Velocity (clean)	2.96 ft/sec	402.62	ft/min

Thermal conductivity of fouling layer, Btu/hr/ft^2/deg F .00

Number of equi-distant air zones along the tube length = 1

Uniform distribution

Heat duty 1000 Btu/Hr (Total/Sensible/Latent) 38315/ 269/ 38045
Avg overall ht coef. (Btu/Hr/SqFt/deg F) 16.49
Gross ht surface area (Sq Ft) 5663
Dew Point temperature, deg F 286.00

Mode of Operation: PERFORMANCE PREDICTION
Name of Data File: C:VCC2C .PPI
File Description:

Component Identification: VCC2C
Component Description:

***** PERFORMANCE DATA *****

Procedure # BLIND FLANGE Date: 05/19/95

	Cooling Water	Hot Air	
Pressure	Not required	74.00	psia
Rel humidity in	Not applicable	100.00	%
Rel humidity out	Not applicable	100.00	%
Flow rate in	480.00 gpm	27378.00	acfm
Temperature in	95.00 deg F	286.00	deg F (db)
Temperature out	238.32 deg F	282.22	deg F (db)
Fouling 1/(Btu/Hr/SqFt/degF)	.0020	.0000	
Pressure Drop (clean)	3.54 psi	Not calculated	
Pressure Drop (fouled)	3.54 psi	Not calculated	
Velocity (clean)	2.54 ft/sec	402.62	ft/min

Thermal conductivity of fouling layer, Btu/hr/ft^2/deg F .00

Number of equi-distant air zones along the tube length = 1

Uniform distribution

Heat duty 1000 Btu/Hr (Total/Sensible/Latent) 34543/ 252/ 34291
Avg overall ht coef. (Btu/Hr/SqFt/deg F) 15.71
Gross ht surface area (Sq Ft) 56[illegible]3
Dew Point temperature, deg F 286.00

95-E-0026-03, R 0
PAGE 6 OF 12

Mode of Operation: PERFORMANCE PREDICTION
Name of Data File: C:VCC2C .PPI
File Description:

Component Identification: VCC2C
Component Description:

***** PERFORMANCE DATA *****

Procedure # BLIND FLANGE Date: 05/19/95

	Cooling Water	Hot Air	
Pressure	Not required	74.00	psia
Rel humidity in	Not applicable	100.00	%
Rel humidity out	Not applicable	100.00	%
Flow rate in	425.00 gpm	27378.00	acfm
Temperature in	95.00 deg F	286.00	deg F (db)
Temperature out	243.35 deg F	282.59	deg F (db)

Fouling 1/(Btu/Hr/SqFt/degF)	.0020	.0000
Pressure Drop (clean)	2.83 psi	Not calculated
Pressure Drop (fouled)	2.83 psi	Not calculated
Velocity (clean)	2.25 ft/sec	402.62 ft/min

Thermal conductivity of fouling layer, Btu/hr/ft^2/deg F .00

Number of equi-distant air zones along the tube length = 1

Uniform distribution

Heat duty 1000 Btu/Hr (Total/Sensible/Latent) 31604/ 238/ 31366
Avg overall ht coef. (Btu/Hr/SqFt/deg F) 15.04
Gross ht surface area (Sq Ft) 5663
Dew Point temperature, deg F 286.00

DOCUMENT TYPE & NO.	95-E-0046-03, REV. 0
ATTACH. 1	PAGE 7 OF 12

Mode of Operation: PERFORMANCE PREDICTION
Name of Data File: C:VCC2C .PPI
File Description:

Component Identification: VCC2C
Component Description:

***** PERFORMANCE DATA *****

Procedure # BLIND FLANGE Date: 05/19/95

	Cooling Water	Hot Air	
Pressure	Not required	74.00	psia
Rel humidity in	Not applicable	100.00	%
Rel humidity out	Not applicable	100.00	%
Flow rate in	400.00 gpm	27378.00	acfm
Temperature in	95.00 deg F	286.00	deg F (db)
Temperature out	245.74 deg F	282.77	deg F (db)

Fouling 1/(Btu/Hr/SqFt/degF)	.0020	.0000	
Pressure Drop (clean)	2.53 psi	Not calculated	
Pressure Drop (fouled)	2.53 psi	Not calculated	
Velocity (clean)	2.12 ft/sec	402.62	ft/min

Thermal conductivity of fouling layer, Btu/hr/ft^2/deg F .00

Number of equi-distant air zones along the tube length = 1

Uniform distribution

Heat duty 1000 Btu/Hr (Total/Sensible/Latent) 30216/ 229/ 29986
Avg overall ht coef. (Btu/Hr/SqFt/deg F) 14.70
Gross ht surface area (Sq Ft) 5663
Dew Point temperature, deg F 286.00

Mode of Operation: PERFORMANCE PREDICTION
Name of Data File: C:VCC2C .PPI
File Description:

Component Identification: VCC2C
Component Description:

***** PERFORMANCE DATA *****

Procedure # BLIND FLANGE Date: 05/19/95

	Cooling Water	Hot Air	
Pressure	Not required	74.00	psia
Rel humidity in	Not applicable	100.00	%
Rel humidity out	Not applicable	100.00	%
Flow rate in	375.00 gpm	27378.00	acfm
Temperature in	95.00 deg F	286.00	deg F (db)
Temperature out	248.23 deg F	282.94	deg F (db)
Fouling 1/(Btu/Hr/SqFt/degF)	.0020	.0000	
Pressure Drop (clean)	2.24 psi	Not calculated	
Pressure Drop (fouled)	2.24 psi	Not calculated	
Velocity (clean)	1.99 ft/sec	402.62	ft/min

Thermal conductivity of fouling layer, Btu/hr/ft^2/deg F .00

Number of equi-distant air zones along the tube length = 1

Uniform distribution

Heat duty 1000 Btu/Hr (Total/Sensible/Latent) 28776/ 221/ 28555
Avg overall ht coef. (Btu/Hr/SqFt/deg F) 14.34
Gross ht surface area (Sq Ft) 5663
Dew Point temperature, deg F 286.00

95-E-0045-03 Rev 0
PAGE 9 OF 12

Mode of Operation: PERFORMANCE PREDICTION
Name of Data File: C:VCC2C .PPI
File Description:

Component Identification: VCC2C
Component Description:

***** PERFORMANCE DATA *****

Procedure # BLIND FLANGE Date: 05/19/95

	Cooling Water	Hot Air	
Pressure	Not required	74.00	psia
Rel humidity in	Not applicable	100.00	%
Rel humidity out	Not applicable	100.00	%
Flow rate in	320.00 gpm	27378.00	acfm
Temperature in	95.00 deg F	286.00	deg F (db)
Temperature out	253.87 deg F	283.33	deg F (db)

Fouling 1/(Btu/Hr/SqFt/degF)	.0020	.0000	
Pressure Drop (clean)	1.68 psi	Not calculated	
Pressure Drop (fouled)	1.68 psi	Not calculated	
Velocity (clean)	1.70 ft/sec	402.62	ft/min

Thermal conductivity of fouling layer, Btu/hr/ft^2/deg F .00

Number of equi-distant air zones along the tube length = 1

Uniform distribution

Heat duty 1000 Btu/Hr (Total/Sensible/Latent) 25478/ 176/ 25302
Avg overall ht coef. (Btu/Hr/SqFt/deg F) 13.49
Gross ht surface area (Sq Ft) 5663
Dew Point temperature, deg F 286.00

95-E-2024-01
1 10 12

Mode of Operation: PERFORMANCE PREDICTION
Name of Data File: C:VCC2C .PPI
File Description:

Component Identification: VCC2C
Component Description:

***** PERFORMANCE DATA *****

Procedure # BLIND FLANGE Date: 05/19/95

	Cooling Water	Hot Air	
Pressure	Not required	74.00	psia
Rel humidity in	Not applicable	100.00	%
Rel humidity out	Not applicable	100.00	%
Flow rate in	240.00 gpm	27378.00	acfm
Temperature in	95.00 deg F	286.00	deg F (db)
Temperature out	259.09 deg F	283.99	deg F (db)

Fouling 1/(Btu/Hr/SqFt/degF)	.0020	.0000
Pressure Drop (clean)	.99 psi	Not calculated
Pressure Drop (fouled)	.99 psi	Not calculated
Velocity (clean)	1.27 ft/sec	402.62 ft/min

Thermal conductivity of fouling layer, Btu/hr/ft^2/deg F .00

Number of equi-distant air zones along the tube length = 1

Uniform distribution

Heat duty 1000 Btu/Hr (Total/Sensible/Latent) 19716/ 127/ 19589
Avg overall ht coef. (Btu/Hr/SqFt/deg F) 10.82
Gross ht surface area (Sq Ft) 5663
Dew Point temperature, deg F 286.00

Mode of Operation: PERFORMANCE PREDICTION
Name of Data File: C:VCC2C .PPI
File Description:

Component Identification: VCC2C
Component Description:

***** PERFORMANCE DATA *****

Procedure # BLIND FLANGE Date: 05/19/95

	Cooling Water	Hot Air	
Pressure	Not required	74.00	psia
Rel humidity in	Not applicable	100.00	%
Rel humidity out	Not applicable	100.00	%
Flow rate in	160.00 gpm	27378.00	acfm
Temperature in	95.00 deg F	286.00	deg F (db)
Temperature out	257.07 deg F	284.72	deg F (db)
Fouling 1/(Btu/Hr/SqFt/degF)	.0020	.0000	
Pressure Drop (clean)	.48 psi	Not calculated	
Pressure Drop (fouled)	.48 psi	Not calculated	
Velocity (clean)	.85 ft/sec	402.62	ft/min

Thermal conductivity of fouling layer, Btu/hr/ft^2/deg F .00

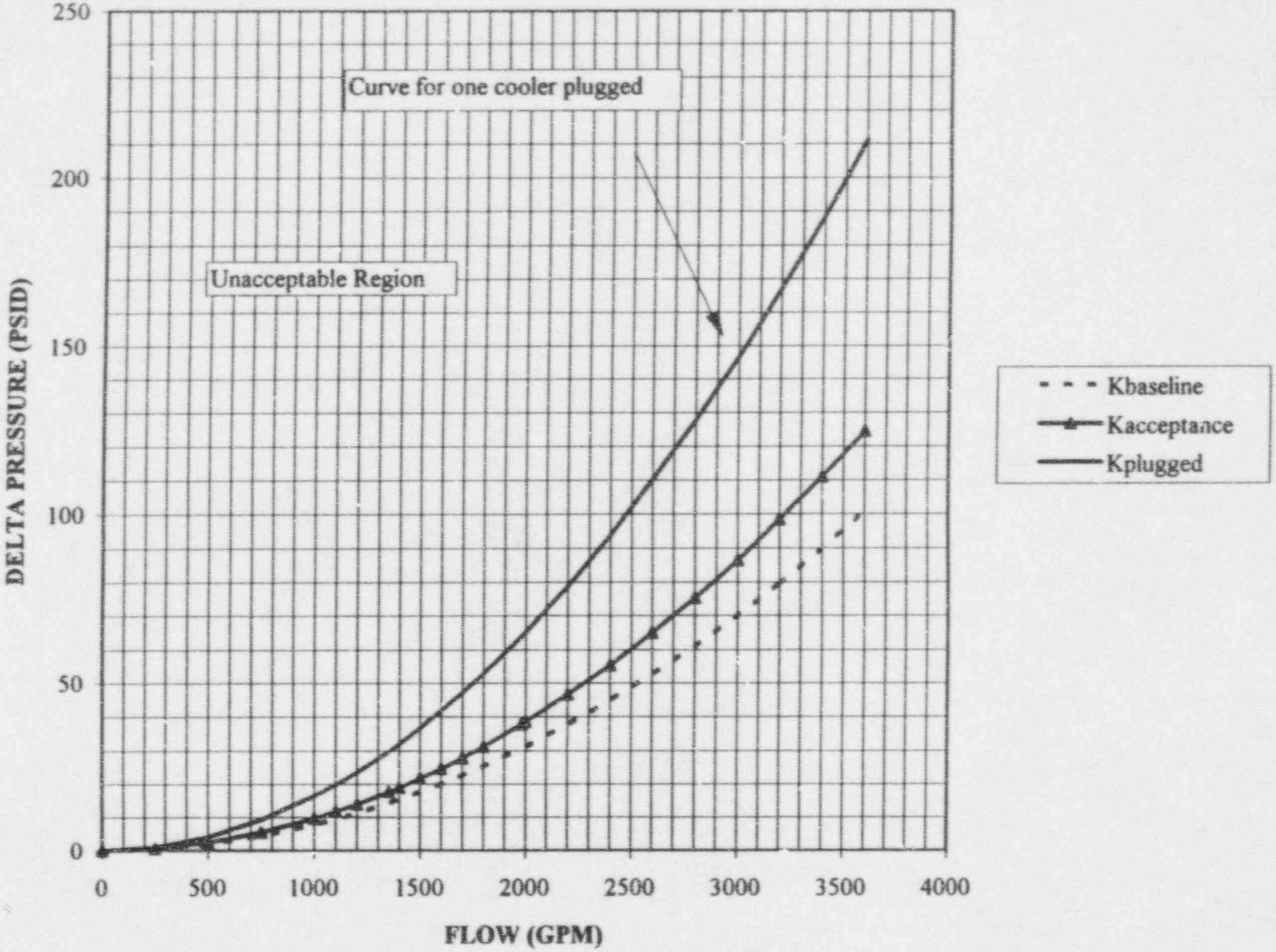
Number of equi-distant air zones along the tube length = 1

Uniform distribution

Heat duty 1000 Btu/Hr (Total/Sensible/Latent) 12964/ 97/ 12867
Avg overall ht coef. (Btu/Hr/SqFt/deg F) 6.86
Gross ht surface area (Sq Ft) 5663
Dew Point temperature, deg F 286.00

95-E-0046-03, Rev 0
12 12

RB COOLER FLOW RESISTANCE CURVES



DOCUMENT TYPE & NO. 95-E-0004-03 REV 0
ATTACH. 2 PAGE 1 OF 2

The following table provides data for these curves:

Flow	DP Kbaseline	DP Kacceptance	DP Kplugged
0	0	0	0
250	0	1	1
500	2	2	4
750	4	5	9
1000	8	10	16
1100	9	12	20
1200	11	14	23
1350	14	17	30
1400	15	19	32
1500	18	22	37
1600	20	25	42
1700	22	28	47
1800	25	31	53
1982	31	38	64
2000	31	38	65
2200	38	46	79
2400	45	55	94
2600	53	65	110
2800	61	75	128
3000	70	86	147
3200	80	98	167
3400	90	111	188
3600	101	124	211

Formulas for curves:

Kb= 7.78E-06 * gpm^2
Ka= 9.60E-06 * gpm^2
Kp= 1.63E-05 * gpm^2

(DATA FROM REF 9)

DOCUMENT TYPE & NO. 95-E-00[illegible]
ATTACH. 2 PAGE 2 OF 2