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Appendix

Appendix A1

Table 1 Equipment blocks

Equipment	Block name	Generic algorithm name	Generic algorithm description
Reserved water tank (TK7)	WIJ_TANK7	TANK	simple tank with heating
RWT isolation valve (MV11)	WIJ_MV11	MOTOR_VLV	motorized valve
RWT isolation valve (MV12)	WIJ_MV12	MOTOR_VLV	motorized valve
RWT isolation valve (MV13)	WIJ_MV13	MOTOR_VLV	motorized valve
RWT isolation valve (MV14)	WIJ_MV14	MOTOR_VLV	motorized valve
Gas tank (TK1)	IJT_TANK1	TANK	simple tank with heating
Gas tank (TK2)	IJT_TANK2	TANK	simple tank with heating
Gas tank (TK3)	IJT_TANK3	TANK	simple tank with heating
Gas tank (TK4)	IJT_TANK4	TANK	simple tank with heating
Gas tank (TK5)	IJT_TANK5	TANK	simple tank with heating
Gas tank (TK6)	IJT_TANK6	TANK	simple tank with heating
Gas isolation valve (MV1)	IJT_MV1	MOTOR_VLV	motorized valve
Gas isolation valve (MV2)	IJT_MV2	MOTOR_VLV	motorized valve
Gas isolation valve (MV3)	IJT_MV3	MOTOR_VLV	motorized valve

Table 1 Equipment blocks (continue)

Gas isolation valve (MV4)	IJT_MV4	MOTOR_VLV	motorized valve
Gas isolation valve (MV5)	IJT_MV5	MOTOR_VLV	motorized valve
Gas isolation valve (MV6)	IJT_MV6	MOTOR_VLV	motorized valve
Water tank isolation valve (MV7)	IJT_MV7	MOTOR_VLV	motorized valve
Water tank isolation valve (MV8)	IJT_MV8	MOTOR_VLV	motorized valve
Recovery pump (P1)	RCR_P1	PUMP_SIM	simple centrifugal pump
Recovery pump (P2)	RCR_P2	PUMP_SIM	simple centrifugal pump
Recovery pump (P3)	RCR_P3	PUMP_SIM	simple centrifugal pump
Recovery pump (P4)	RCR_P4	PUMP_SIM	simple centrifugal pump
Recovery pump P1 motor	RCR_P1_MTR	MOTOR	simple motor model
Recovery pump P2 motor	RCR_P2_MTR	MOTOR	simple motor model
Recovery pump P3 motor	RCR_P3_MTR	MOTOR	simple motor model
Recovery pump P4 motor	RCR_P4_MTR	MOTOR	simple motor model
Heat exchanger (HX1)	RCR_HX1	HX_SIM	simple HX (liquid to liquid)
Heat exchanger (HX2)	RCR_HX2	HX_SIM	simple HX (liquid to liquid)
Heat exchanger (HX3)	RCR_HX3	HX_SIM	simple HX (liquid to liquid)

Table 1 Equipment blocks (continue)

Heat exchanger (HX4)	RCR_HX4	HX_SIM	simple HX (liquid to liquid)
Low pressure isolation valve (MV9)	RCR_MV9	MOTOR_VLV	motorized valve
Low pressure isolation valve (MV10)	RCR_MV10	MOTOR_VLV	motorized valve
Sump isolation valve (MV15)	RCR_MV15	MOTOR_VLV	motorized valve
Sump isolation valve (MV16)	RCR_MV16	MOTOR_VLV	motorized valve
Sump isolation valve (MV17)	RCR_MV17	MOTOR_VLV	motorized valve
Sump isolation valve (MV18)	RCR_MV18	MOTOR_VLV	motorized valve
Test/recirculation valve (MV19)	RCR_MV19	MOTOR_VLV	motorized valve
Test/recirculation valve (MV20)	RCR_MV20	MOTOR_VLV	motorized valve
Testing sump isolation valve (MV21)	RCR_MV21	MOTOR_VLV	motorized valve
Testing sump isolation valve (MV22)	RCR_MV22	MOTOR_VLV	motorized valve
Testing sump isolation valve (MV23)	RCR_MV23	MOTOR_VLV	motorized valve
Testing sump isolation valve (MV24)	RCR_MV24	MOTOR_VLV	motorized valve

Table 2 Network blocks

Node/branch	Block-name	Generic algorithm name	Generic algorithm description
external node01	NHW_X01	H_NET_EXT	network external node
external node02	NHW_X02	H_NET_EXT	network external node
internal node02	NHW_N01	H_NET_INT	network internal node
branch from external node01 to internal node01	NHWX01_NO1	H_NET_LINK	network branch/link
branch1 from internal node01 to external node02	NHWN01_X02_1	H_NET_LINK	network branch/link
branch2 from internal node01 to external node02	NHWN01_X02_2	H_NET_LINK	network branch/link
external node01	NHI_X01	H_NET_EXT	network external node
external node02	NHI_X02	H_NET_EXT	network external node
external node03	NHI_X03	H_NET_EXT	network external node
external node04	NHI_X04	H_NET_EXT	network external node
internal node01	NHI_N01	H_NET_INT	network internal node
internal node02	NHI_N02	H_NET_INT	network internal node
internal node03	NHI_N03	H_NET_INT	network internal node

Table 2 Network blocks (continue)

internal node04	NHI_N04	H_NET_INT	network internal node
internal node05	NHI_N05	H_NET_INT	network internal node
internal node06	NHI_N06	H_NET_INT	network internal node
internal node07	NHI_N07	H_NET_INT	network internal node
branch from external node01 to internal node01	NHIX01_N01	H_NET_LINK	network branch/link
branch from external node01 to internal node02	NHIX01_N02	H_NET_LINK	network branch/link
branch from internal node01 to internal node03	NHIN01_N03	H_NET_LINK	network branch/link
branch from internal node02 to internal node03	NHIN02_N03	H_NET_LINK	network branch/link
branch from internal node03 to internal node04	NHIN03_N04	H_NET_LINK	network branch/link
branch from internal node04 to internal node05	NHIN04_N05	H_NET_LINK	network branch/link
branch from internal node04 to internal node06	NHIN04_N06	H_NET_LINK	network branch/link

Table 2 Network blocks (continue)

branch from internal node04 to internal node07	NHIN04_N07	H_NET_LINK	network branch/link
branch from internal node05 to external node02	NHIN05_X02	H_NET_LINK	network branch/link
branch from internal node06 to external node03	NHIN06_X03	H_NET_LINK	network branch/link
branch from internal node07 to external node04	NHIN07_X04	H_NET_LINK	network branch/link
external node01	NHJ_X01	H_NET_EXT	network external node
external node02	NHJ_X02	H_NET_EXT	network external node
external node03	NHJ_X03	H_NET_EXT	network external node
external node04	NHJ_X04	H_NET_EXT	network external node
internal node01	NHJ_N01	H_NET_INT	network internal node
internal node02	NHJ_N02	H_NET_INT	network internal node
internal node03	NHJ_N03	H_NET_INT	network internal node
internal node04	NHJ_N04	H_NET_INT	network internal node
internal node05	NHJ_N05	H_NET_INT	network internal node
internal node06	NHJ_N06	H_NET_INT	network internal node

Table 2 Network blocks (continue)

internal node07	NHJ_N07	H_NET_INT	network internal node
branch from external node01 to internal node01	NHJX01_N01	H_NET_LINK	network branch/link
branch from external node01 to internal node02	NHJX01_N02	H_NET_LINK	network branch/link
branch from internal node01 to internal node03	NHJN01_N03	H_NET_LINK	network branch/link
branch from internal node02 to internal node03	NHJN02_N03	H_NET_LINK	network branch/link
branch from internal node03 to internal node04	NHJN03_N04	H_NET_LINK	network branch/link
branch from internal node04 to internal node05	NHJN04_N05	H_NET_LINK	network branch/link
branch from internal node04 to internal node06	NHJN04_N06	H_NET_LINK	network branch/link
branch from internal node04 to internal node07	NHJN04_N07	H_NET_LINK	network branch/link

Table 2 Network blocks (continue)

branch from internal node05 to external node02	NHJN05_X02	H_NET_LINK	network branch/link
branch from internal node06 to external node03	NHJN06_X03	H_NET_LINK	network branch/link
branch from internal node07 to external node04	NHJN07_X04	H_NET_LINK	network branch/link
external node01	NHR_X01	H_NET_EXT	network external node
external node02	NHR_X02	H_NET_EXT	network external node
external node03	NHR_X03	H_NET_EXT	network external node
external node04	NHR_X04	H_NET_EXT	network external node
external node05	NHR_X05	H_NET_EXT	network external node
external node06	NHR_X06	H_NET_EXT	network external node
internal node01	NHR_N01	H_NET_INT	network internal node
internal node02	NHR_N02	H_NET_INT	network internal node
internal node03	NHR_N03	H_NET_INT	network internal node
internal node04	NHR_N04	H_NET_INT	network internal node
internal node05	NHR_N05	H_NET_INT	network internal node
internal node06	NHR_N06	H_NET_INT	network internal node

Table 2 Network blocks (continue)

internal node07	NHR_N07	H_NET_INT	network internal node
internal node08	NHR_N08	H_NET_INT	network internal node
internal node09	NHR_N09	H_NET_INT	network internal node
internal node10	NHR_N10	H_NET_INT	network internal node
internal node11	NHR_N11	H_NET_INT	network internal node
internal node12	NHR_N12	H_NET_INT	network internal node
internal node13	NHR_N13	H_NET_INT	network internal node
internal node14	NHR_N14	H_NET_INT	network internal node
internal node15	NHR_N15	H_NET_INT	network internal node
internal node16	NHR_N16	H_NET_INT	network internal node
internal node17	NHR_N17	H_NET_INT	network internal node
internal node18	NHR_N18	H_NET_INT	network internal node
internal node19	NHR_N19	H_NET_INT	network internal node
internal node20	NHR_N20	H_NET_INT	network internal node
internal node21	NHR_N21	H_NET_INT	network internal node
internal node22	NHR_N22	H_NET_INT	network internal node
internal node23	NHR_N23	H_NET_INT	network internal node

Table 2 Network blocks (continue)

branch from external node01 to internal node20	NHRX01_N20	H_NET_LINK	network branch/link
branch from external node02 to internal node21	NHRX02_N21	H_NET_LINK	network branch/link
branch from external node03 to internal node22	NHRX03_N22	H_NET_LINK	network branch/link
branch from external node04 to internal node23	NHRX04_N23	H_NET_LINK	network branch/link
branch from internal node20 to internal node01	NHRN20_N01	H_NET_LINK	network branch/link
branch from internal node21 to internal node02	NHRN21_N02	H_NET_LINK	network branch/link
branch from internal node22 to internal node03	NHRN22_N03	H_NET_LINK	network branch/link
branch from internal node23 to internal node04	NHRN23_N04	H_NET_LINK	network branch/link
branch from internal node01 to internal node05	NHRN01_N05	H_NET_LINK	network branch/link

Table 2 Network blocks (continue)

branch from internal node02 to internal node06	NHRN02_N06	H_NET_LINK	network branch/link
branch from internal node03 to internal node07	NHRN03_N07	H_NET_LINK	network branch/link
branch from internal node04 to internal node08	NHRN04_N08	H_NET_LINK	network branch/link
branch from internal node05 to internal node16	NHRN05_N16	H_NET_LINK	network branch/link
branch from internal node06 to internal node17	NHRN06_N17	H_NET_LINK	network branch/link
branch from internal node07 to internal node18	NHRN07_N18	H_NET_LINK	network branch/link
branch from internal node08 to internal node19	NHRN80_N19	H_NET_LINK	network branch/link
branch from internal node16 to internal node01	NHRN16_N01	H_NET_LINK	network branch/link
branch from internal node17 to internal node02	NHRN17_N02	H_NET_LINK	network branch/link

Table 2 Network blocks (continue)

branch from internal node18 to internal node03	NHRN18_N03	H_NET_LINK	network branch/link
branch from internal node19 to internal node04	NHRN19_N04	H_NET_LINK	network branch/link
branch from internal node05 to internal node09	NHRN05_N09	H_NET_LINK	network branch/link
branch from internal node06 to internal node09	NHRN06_N09	H_NET_LINK	network branch/link
branch from internal node07 to internal node11	NHRN07_N11	H_NET_LINK	network branch/link
branch from internal node08 to internal node11	NHRN08_N11	H_NET_LINK	network branch/link
branch1 from internal node09 to internal node10	NHRN09_N10_1	H_NET_LINK	network branch/link
branch2 from internal node09 to internal node10	NHRN09_N10_2	H_NET_LINK	network branch/link
branch1 from internal node11 to internal node12	NHRN11_N12_1	H_NET_LINK	network branch/link

Table 2 Network blocks (continue)

branch2 from internal node11 to internal node12	NHRN11_N12_2	H_NET_LINK	network branch/link
branch from internal node10 to internal node15	NHRN10_N15	H_NET_LINK	network branch/link
branch from internal node15 to external node05	NHRN15_X05	H_NET_LINK	network branch/link
branch from internal node15 to external node06	NHRN15_X06	H_NET_LINK	network branch/link
branch1 from internal node10 to internal node13	NHRN10_N13_1	H_NET_LINK	network branch/link
branch2 from internal node10 to internal node13	NHRN10_N13_2	H_NET_LINK	network branch/link
branch1 from internal node12 to internal node14	NHRN12_N14_1	H_NET_LINK	network branch/link
branch2 from internal node12 to internal node14	NHRN12_N14_2	H_NET_LINK	network branch/link
branch from internal node13 to internal node20	NHRN13_N20	H_NET_LINK	network branch/link

Table 2 Network blocks (continue)

branch from internal node13 to internal node21	NHRN13_N21	H_NET_LINK	network branch/link
branch from internal node14 to internal node22	NHRN14_N22	H_NET_LINK	network branch/link
branch from internal node14 to internal node23	NHRN14_N23	H_NET_LINK	network branch/link
branch from internal node09 to internal node10	NHRN09_N10	H_NET_LINK	network branch/link
branch from internal node11 to internal node12	NHRN11_N12	H_NET_LINK	network branch/link
branch from internal node10 to internal node13	NHRN10_N13	H_NET_LINK	network branch/link
branch from internal node12 to internal node14	NHRN12_N15	H_NET_LINK	network branch/link
external node01	NHM_X01	H_NET_EXT	network external node
external node02	NHM_X02	H_NET_EXT	network external node
external node03	NHM_X03	H_NET_EXT	network external node
internal node01	NHM_N01	H_NET_INT	network internal node

Table 2 Network blocks (continue)

internal node02	NHM_N02	H_NET_INT	network internal node
internal node03	NHM_N03	H_NET_INT	network internal node
internal node04	NHM_N04	H_NET_INT	network internal node
internal node05	NHM_N05	H_NET_INT	network internal node
internal node06	NHM_N06	H_NET_INT	network internal node
internal node07	NHM_N07	H_NET_INT	network internal node
internal node08	NHM_N08	H_NET_INT	network internal node
internal node09	NHM_N09	H_NET_INT	network internal node
internal node10	NHM_N10	H_NET_INT	network internal node
internal node11	NHM_N11	H_NET_INT	network internal node
internal node12	NHM_N12	H_NET_INT	network internal node
internal node13	NHM_N13	H_NET_INT	network internal node
internal node14	NHM_N14	H_NET_INT	network internal node
internal node15	NHM_N15	H_NET_INT	network internal node
internal node16	NHM_N16	H_NET_INT	network internal node
internal node17	NHM_N17	H_NET_INT	network internal node
internal node18	NHM_N18	H_NET_INT	network internal node
internal node19	NHM_N19	H_NET_INT	network internal node

Table 2 Network blocks (continue)

internal node20	NHM_N20	H_NET_INT	network internal node
internal node21	NHM_N21	H_NET_INT	network internal node
internal node22	NHM_N22	H_NET_INT	network internal node
internal node23	NHM_N23	H_NET_INT	network internal node
internal node24	NHM_N24	H_NET_INT	network internal node
internal node25	NHM_N25	H_NET_INT	network internal node
internal node26	NHM_N26	H_NET_INT	network internal node
internal node27	NHM_N27	H_NET_INT	network internal node
internal node28	NHM_N28	H_NET_INT	network internal node
internal node29	NHM_N29	H_NET_INT	network internal node
internal node30	NHM_N30	H_NET_INT	network internal node
internal node31	NHM_N31	H_NET_INT	network internal node
internal node32	NHM_N32	H_NET_INT	network internal node
internal node33	NHM_N33	H_NET_INT	network internal node
internal node34	NHM_N34	H_NET_INT	network internal node
internal node35	NHM_N35	H_NET_INT	network internal node
branch from internal node17 to internal node01	NHMN17_N01	H_NET_LINK	network branch/link

Table 2 Network blocks (continue)

branch from internal node01 to internal node02	NHMN01_N02	H_NET_LINK	network branch/link
branch from internal node02 to internal node03	NHMN02_N03	H_NET_LINK	network branch/link
branch from internal node03 to internal node04	NHMN03_N04	H_NET_LINK	network branch/link
branch from internal node04 to internal node19	NHMN04_N19	H_NET_LINK	network branch/link
branch from internal node19 to internal node20	NHMN19_N20	H_NET_LINK	network branch/link
branch from internal node20 to internal node21	NHMN20_N21	H_NET_LINK	network branch/link
branch from internal node21 to internal node18	NHMN21_N18	H_NET_LINK	network branch/link
branch from internal node04 to external node02	NHMN04_X02	H_NET_LINK	network branch/link
branch from internal node19 to external node03	NHMN19_X03	H_NET_LINK	network branch/link

Table 2 Network blocks (continue)

branch from internal node17 to internal node05	NHMN17_N05	H_NET_LINK	network branch/link
branch from internal node05 to internal node06	NHMN05_N06	H_NET_LINK	network branch/link
branch from internal node06 to internal node07	NHMN06_N07	H_NET_LINK	network branch/link
branch from internal node07 to internal node08	NHMN07_N08	H_NET_LINK	network branch/link
branch from internal node08 to internal node22	NHMN08_N22	H_NET_LINK	network branch/link
branch from internal node22 to internal node23	NHMN22_N23	H_NET_LINK	network branch/link
branch from internal node23 to internal node24	NHMN23_N24	H_NET_LINK	network branch/link
branch from internal node24 to internal node18	NHMN24_N18	H_NET_LINK	network branch/link
branch from internal node18 to internal node09	NHMN18_N09	H_NET_LINK	network branch/link

Table 2 Network blocks (continue)

branch from internal node10 to internal node11	NHMN10_N11	H_NET_LINK	network branch/link
branch from internal node11 to internal node12	NHMN11_N12	H_NET_LINK	network branch/link
branch from internal node12 to internal node25	NHMN12_N25	H_NET_LINK	network branch/link
branch from internal node25 to internal node26	NHMN25_N26	H_NET_LINK	network branch/link
branch from internal node26 to internal node27	NHMN26_N27	H_NET_LINK	network branch/link
branch from internal node27 to internal node17	NHMN27_N17	H_NET_LINK	network branch/link
branch from internal node18 to internal node13	NHMN18_N13	H_NET_LINK	network branch/link
branch from internal node13 to internal node14	NHMN13_N14	H_NET_LINK	network branch/link
branch from internal node14 to internal node15	NHMN14_N15	H_NET_LINK	network branch/link

Table 2 Network blocks (continue)

branch from internal node15 to internal node16	NHMN15_N16	H_NET_LINK	network branch/link
branch from internal node16 to internal node28	NHMN16_N28	H_NET_LINK	network branch/link
branch from internal node28 to internal node29	NHMN28_N29	H_NET_LINK	network branch/link
branch from internal node29 to internal node30	NHMN29_N30	H_NET_LINK	network branch/link
branch from internal node30 to internal node17	NHMN30_N17	H_NET_LINK	network branch/link
branch from internal node17. to external node01	NHMN17_X01	H_NET_LINK	network branch/link
branch from internal node17 to internal node31	NHMN17_N31	H_NET_LINK	network branch/link
branch from internal node31 to internal node18	NHMN31_N18	H_NET_LINK	network branch/link
branch from internal node02 to internal node32	NHMN02_N32	H_NET_LINK	network branch/link

Table 2 Network blocks (continue)

branch from internal node32 to internal node03	NHMN32_N03	H_NET_LINK	network branch/link
branch from internal node06 to internal node33	NHMN06_N33	H_NET_LINK	network branch/link
branch from internal node33 to internal node07	NHMN33_N07	H_NET_LINK	network branch/link
branch from internal node10 to internal node34	NHMN10_N34	H_NET_LINK	network branch/link
branch from internal node34 to internal node11	NHMN34_N11	H_NET_LINK	network branch/link
branch from internal node14 to internal node35	NHMN14_N35	H_NET_LINK	network branch/link
branch from internal node35 to internal node15	NHMN35_N15	H_NET_LINK	network branch/link

Table 3 Analog control blocks

Description	Block name	Process connections
RWT level	CWI_LT1	WIJ_TANK7/L1
RWT temperature	CWI_TT1	WIJ_TANK7/T1
Flow entering ROH1	CIJ_FT1	NHJN07_X04/FM1
Flow entering RIH3	CIJ_FT2	NHJN06_X03/FM1

Table 3 Analog control blocks (continue)

Flow entering RIH1	CIJ_FT3	NHJN05_X02/FM1
Flow entering RIH2	CIJ_FT4	NHIN07_X04/FM1
Flow entering RIH4	CIJ_FT5	NHIN06_X03/FM1
Flow entering ROH2	CIJ_FT6	NHIN05_X02/FM1
Water tank 3 level	CIJ_LT1	IJT_TANK3/L1
Water tank 4 level	CIJ_LT2	IJT_TANK4/L1
Water tank 5 level	CIJ_LT3	IJT_TANK5/L1
Water tank 6 level	CIJ_LT4	IJT_TANK6/L1
ROH1 pressure	CIJ_PT1	NHM_N17/P1
ROH2 pressure	CIJ_PT2	NHM_N18/P1
Gas injection line pressure	CIJ_PT3	NHI_N04/P1
ECC injection line1 pressure	CIJ_PT4	NHI_N04/P1
ECC injection line2 pressure	CIJ_PT5	NHJ_N04/P1
Water tank 3 temperature	CIJ_TT1	IJT_TANK3/T1
Water tank 4 temperature	CIJ_TT2	IJT_TANK4/T1
Water tank 5 temperature	CIJ_TT3	IJT_TANK5/T1
Water tank 6 temperature	CIJ_TT4	IJT_TANK6/T1
P1,P2 discharge flow	CRC_FT1	NHRN01_N05/FM1
P3,P4 discharge flow	CRC_FT2	NHRN12_N15/FM1
RB1 water level	CRC_LT1	RCR_RB1/L1
RB2 water level	CRC_LT2	RCR_RB2/L1
RB3 water level	CRC_LT3	RCR_RB3/L1
RB4 water level	CRC_LT4	RCR_RB4/L1
Moderator level	CRC_LT5	$ moderator level
HX1-HX4 inlet temperature	CRC_TT1	RCR_OUTF1/G1
HX1,HX2 outlet temperature	CRC_TT2	RCR_T2OUTF/G1

Table 3 Analog control blocks (continue)

HX3,HX4 outlet temperature	CRC_TT3	RCR_T3OUTF/G1

Table 4 Digital control blocks

Description	Block name	Process connections
RWT level switch	CWI_LS1	WIJ_TANK7/L1
TANK3 level switch	CIJ_LS1	IJT_TANK3/L1
TANK4 level switch	CIJ_LS2	IJT_TANK4/L1
TANK5 level switch	CIJ_LS3	IJT_TANK5/L1
TANK6 level switch	CIJ_LS4	IJT_TANK6/L1
RB1 level switch	CRC_LS1	RCR_RB1/L1
RB2 level switch	CRC_LS2	RCR_RB2/L1
RB3 level switch	CRC_LS3	RCR_RB3/L1
RB4 level switch	CRC_LS4	RCR_RB4/L1

Table 5 Sequence blocks

Description	Block name
Sequence permissive	ECC_PERM
Step complete tieback	ECC_TIEBACK
Sequence control	ECC_SEQUENCE
Sequence permissive	CWI_PERM
Step complete tieback	CWI_TIEBACK
Sequence control	CWI_SEQUENCE
Sequence permissive	CIJ_SEQ_PERM
Step complete tieback	CIJ_TIEBACK
Sequence control	CIJ_SEQUENCE
Sequence permissive	CRC_SEQ_PER1
Sequence permissive	CRC_SEQ_PER2
Sequence permissive	CRC_SEQ_PERM
Step complete tieback	CRC_TIEBACK
Sequence control	CRC_SEQUENCE

Table 6 Equipment control blocks

Equipment	Block name	Algorithm used
Motorized valve MV11	CWI_MV11_AMS	AUTOSTMAN
Motorized valve MV12	CWI_MV12_AMS	AUTOSTMAN
Motorized valve MV13	CWI_MV13_AMS	AUTOSTMAN
Motorized valve MV14	CWI_MV14_AMS	AUTOSTMAN
Motorized valve MV11	CWI_MV11_OCR	OPRSTCL
Motorized valve MV12	CWI_MV12_OCR	OPRSTCL
Motorized valve MV13	CWI_MV13_OCR	OPRSTCL
Motorized valve MV14	CWI_MV14_OCR	OPRSTCL
Motorized valve MV11	CWI_MV11_OPR	2-OR
Motorized valve MV12	CWI_MV12_OPR	2-OR
Motorized valve MV13	CWI_MV13_OPR	2-OR
Motorized valve MV14	CWI_MV14_OPR	2-OR
Motorized valve MV11	CWI_MV11_CLR	2-OR
Motorized valve MV12	CWI_MV12_CLR	2-OR
Motorized valve MV13	CWI_MV13_CLR	2-OR
Motorized valve MV14	CWI_MV14_CLR	2-OR
Motorized valve MV11	CWI_MV11_OP	BREAKER
Motorized valve MV12	CWI_MV12_OP	BREAKER
Motorized valve MV13	CWI_MV13_OP	BREAKER
Motorized valve MV14	CWI_MV14_OP	BREAKER
Motorized valve MV11	CWI_MV11_CL	BREAKER
Motorized valve MV12	CWI_MV12_CL	BREAKER
Motorized valve MV13	CWI_MV13_CL	BREAKER
Motorized valve MV14	CWI_MV14_CL	BREAKER
Motorized valve MV1	CIJ_MV1_AMS	AUTOSTMAN
Motorized valve MV2	CIJ_MV2_AMS	AUTOSTMAN
Motorized valve MV3	CIJ_MV3_AMS	AUTOSTMAN
Motorized valve MV4	CIJ_MV4_AMS	AUTOSTMAN
Motorized valve MV5	CIJ_MV5_AMS	AUTOSTMAN
Motorized valve MV6	CIJ_MV6_AMS	AUTOSTMAN
Motorized valve MV7	CIJ_MV7_AMS	AUTOSTMAN
Motorized valve MV8	CIJ_MV8_AMS	AUTOSTMAN
Motorized valve MV1	CIJ_MV1_OCR	OPRSTCL
Motorized valve MV2	CIJ_MV2_OCR	OPRSTCL

Table 6 Equipment control blocks (continue)

Motorized valve MV3	CIJ_MV3_OCR	OPRSTCL
Motorized valve MV4	CIJ_MV4_OCR	OPRSTCL
Motorized valve MV5	CIJ_MV5_OCR	OPRSTCL
Motorized valve MV6	CIJ_MV6_OCR	OPRSTCL
Motorized valve MV7	CIJ_MV7_OCR	OPRSTCL
Motorized valve MV8	CIJ_MV8_OCR	OPRSTCL
Motorized valve MV1	CIJ_MV1_OPR	2-OR
Motorized valve MV2	CIJ_MV2_OPR	2-OR
Motorized valve MV3	CIJ_MV3_OPR	2-OR
Motorized valve MV4	CIJ_MV4_OPR	2-OR
Motorized valve MV5	CIJ_MV5_OPR	2-OR
Motorized valve MV6	CIJ_MV6_OPR	2-OR
Motorized valve MV7	CIJ_MV7_OPR	2-OR
Motorized valve MV8	CIJ_MV8_OPR	2-OR
Motorized valve MV1	CIJ_MV1_CLR	2-OR
Motorized valve MV2	CIJ_MV2_CLR	2-OR
Motorized valve MV3	CIJ_MV3_CLR	2-OR
Motorized valve MV4	CIJ_MV4_CLR	2-OR
Motorized valve MV5	CIJ_MV5_CLR	2-OR
Motorized valve MV6	CIJ_MV6_CLR	2-OR
Motorized valve MV7	CIJ_MV7_CLR	2-OR
Motorized valve MV8	CIJ_MV8_CLR	2-OR
Motorized valve MV1	CIJ_MV1_OP	BREAKER
Motorized valve MV2	CIJ_MV2_OP	BREAKER
Motorized valve MV3	CIJ_MV3_OP	BREAKER
Motorized valve MV4	CIJ_MV4_OP	BREAKER
Motorized valve MV5	CIJ_MV5_OP	BREAKER
Motorized valve MV6	CIJ_MV6_OP	BREAKER
Motorized valve MV7	CIJ_MV7_OP	BREAKER
Motorized valve MV8	CIJ_MV8_OP	BREAKER
Motorized valve MV1	CIJ_MV1_CL	BREAKER
Motorized valve MV2	CIJ_MV2_CL	BREAKER
Motorized valve MV3	CIJ_MV3_CL	BREAKER
Motorized valve MV4	CIJ_MV4·CL	BREAKER
Motorized valve MV5	CIJ_MV5_CL	BREAKER

Table 6 Equipment control blocks (continue)

Motorized valve MV6	CiJ_MV6_CL	BREAKER
Motorized valve MV7	CIJ_MV7_CL	BREAKER
Motorized valve MV8	CIJ_MV8_CL	BREAKER
Pump P1	CRC_P1_AMS	AUTOSTMAN
Pump P2	CRC_P2_AMS	AUTOSTMAN
Pump P3	CRC_P3_AMS	AUTOSTMAN
Pump P4	CRC_P4_AMS	AUTOSTMAN
Pump P1	CRC_P1_STSPR	OPRSTCL
Pump P2	CRC_P2_STSPR	OPRSTCL
Pump P3	CRC_P3_STSPR	OPRSTCL
Pump P4	CRC_P4_STSPR	OPRSTCL
Pump P1	CRC_P1_BRK	BREAKER
Pump P2	CRC_P2_BRK	BREAKER
Pump P3	CRC_P3_BRK	BREAKER
Pump P4	CRC_P4_BRK	BREAKER
Motorized valve MV9	CRC_MV9_AMS	AUTOSTMAN
Motorized valve MV10	CRC_MV10_AMS	AUTOSTMAN
Motorized valve MV15	CRC_MV15_AMS	AUTOSTMAN
Motorized valve MV16	CRC_MV16_AMS	AUTOSTMAN
Motorized valve MV17	CRC_MV17_AMS	AUTOSTMAN
Motorized valve MV18	CRC_MV18_AMS	AUTOSTMAN
Motorized valve MV19	CRC_MV19_AMS	AUTOSTMAN
Motorized valve MV20	CRC_MV20_AMS	AUTOSTMAN
Motorized valve MV21	CRC_MV21_AMS	AUTOSTMAN
Motorized valve MV22	CRC_MV22_AMS	AUTOSTMAN
Motorized valve MV23	CRC_MV23_AMS	AUTOSTMAN
Motorized valve MV24	CRC_MV24_AMS	AUTOSTMAN
Motorized valve MV9	CRC_MV9_OCR	OPRSTCL
Motorized valve MV10	CRC_MV10_OCR	OPRSTCL
Motorized valve MV15	CRC_MV15_OCR	OPRSTCL
Motorized valve MV16	CRC_MV16_OCR	OPRSTCL
Motorized valve MV17	CRC_MV17_OCR	OPRSTCL
Motorized valve MV18	CRC_MV18_OCR	OPRSTCL
Motorized valve MV19	CRC_MV19_OCR	OPRSTCL
Motorized valve MV20	CRC_MV20_OCR	OPRSTCL

Table 6 Equipment control blocks (continue)

Motorized valve MV21	CRC_MV21_OCR	OPRSTCL
Motorized valve MV22	CRC_MV22_OCR	OPRSTCL
Motorized valve MV23	CRC_MV23_OCR	OPRSTCL
Motorized valve MV24	CRC_MV24_OCR	OPRSTCL
Motorized valve MV9	CRC_MV9_OPR	2-OR
Motorized valve MV10	CRC_MV10_OPR	2-OR
Motorized valve MV15	CRC_MV15_OPR	2-OR
Motorized valve MV16	CRC_MV16_OPR	2-OR
Motorized valve MV17	CRC_MV17_OPR	2-OR
Motorized valve MV18	CRC_MV18_OPR	2-OR
Motorized valve MV19	CRC_MV19_OPR	2-OR
Motorized valve MV20	CRC_MV20_OPR	2-OR
Motorized valve MV21	CRC_MV21_OPR	2-OR
Motorized valve MV22	CRC_MV22_OPR	2-OR
Motorized valve MV23	CRC_MV23_OPR	2-OR
Motorized valve MV24	CRC_MV24_OPR	2-OR
Motorized valve MV9	CRC_MV9_CLR	2-OR
Motorized valve MV10	CRC_MV10_CLR	2-OR
Motorized valve MV15	CRC_MV15_CLR	2-OR
Motorized valve MV16	CRC_MV16_CLR	2-OR
Motorized valve MV17	CRC_MV17_CLR	2-OR
Motorized valve MV18	CRC_MV18_CLR	2-OR
Motorized valve MV19	CRC_MV19_CLR	2-OR
Motorized valve MV20	CRC_MV20_CLR	2-OR
Motorized valve MV21	CRC_MV21_CLR	2-OR
Motorized valve MV22	CRC_MV22_CLR	2-OR
Motorized valve MV23	CRC_MV23_CLR	2-OR
Motorized valve MV24	CRC_MV24_CLR	2-OR
Motorized valve MV9	CRC_MV9_OP	BREAKER
Motorized valve MV10	CRC_MV10_OP	BREAKER
Motorized valve MV15	CRC_MV15_OP	BREAKER
Motorized valve MV16	CRC_MV16_OP	BREAKER
Motorized valve MV17	CRC_MV17_OP	BREAKER
Motorized valve MV18	CRC_MV18_OP	BREAKER
Motorized valve MV19	CRC_MV19_OP	BREAKER

Table 6 Equipment control blocks (continue)

Motorized valve MV20	CRC_MV20_OP	BREAKER
Motorized valve MV21	CRC_MV21_OP	BREAKER
Motorized valve MV22	CRC_MV22_OP	BREAKER
Motorized valve MV23	CRC_MV23_OP	BREAKER
Motorized valve MV24	CRC_MV24_OP	BREAKER
Motorized valve MV9	CRC_MV9_CL	BREAKER
Motorized valve MV10	CRC_MV10_CL	BREAKER
Motorized valve MV15	CRC_MV15_CL	BREAKER
Motorized valve MV16	CRC_MV16_CL	BREAKER
Motorized valve MV17	CRC_MV17_CL	BREAKER
Motorized valve MV18	CRC_MV18_CL	BREAKER
Motorized valve MV19	CRC_MV19_CL	BREAKER
Motorized valve MV20	CRC_MV20_CL	BREAKER
Motorized valve MV21	CRC_MV21_CL	BREAKER
Motorized valve MV22	CRC_MV22_CL	BREAKER
Motorized valve MV23	CRC_MV23_CL	BREAKER
Motorized valve MV24	CRC_MV24_CL	BREAKER

Table 7 EIB blocks

Equipment	Block name	Algorithm used
Motorized valve MV1	EIB_MV1	EQUIP_CNTL
Motorized valve MV2	EIB_MV2	EQUIP_CNTL
Motorized valve MV3	EIB_MV3	EQUIP_CNTL
Motorized valve MV4	EIB_MV4	EQUIP_CNTL
Motorized valve MV5	EIB_MV5	EQUIP_CNTL
Motorized valve MV6	EIB_MV6	EQUIP_CNTL
Motorized valve MV7	EIB_MV7	EQUIP_CNTL
Motorized valve MV8	EIB_MV8	EQUIP_CNTL
Motorized valve MV9	EIB_MV9	EQUIP_CNTL
Motorized valve MV10	EIB_MV10	EQUIP_CNTL
Motorized valve MV11	EIB_MV11	EQUIP_CNTL
Motorized valve MV12	EIB_MV12	EQUIP_CNTL
Motorized valve MV13	EIB_MV13	EQUIP_CNTL

Table 7 EIB blocks (continue)

Motorized valve MV14	EIB_MV14	EQUIP_CNTL
Motorized valve MV15	EIB_MV15	EQUIP_CNTL
Motorized valve MV16	EIB_MV16	EQUIP_CNTL
Motorized valve MV17	EIB_MV17	EQUIP_CNTL
Motorized valve MV18	EIB_MV18	EQUIP_CNTL
Motorized valve MV19	EIB_MV19	EQUIP_CNTL
Motorized valve MV20	EIB_MV20	EQUIP_CNTL
Motorized valve MV21	EIB_MV21	EQUIP_CNTL
Motorized valve MV22	EIB_MV22	EQUIP_CNTL
Motorized valve MV23	EIB_MV23	EQUIP_CNTL
Pump P1	EIB_P1	EQUIP_CNTL
Pump P2	EIB_P2	EQUIP_CNTL
Pump P3	EIB_P3	EQUIP_CNTL
Pump P4	EIB_P4	EQUIP_CNTL

Table 8 Malfunction blocks

Block name	Algorithm used
MALF_MASTER1	MALF_MASTER
MALF_DECODER1	MALF_DECODER
MALF_ME001	MALF_ANALOG
MALF_ME002	MALF_ANALOG
MALF_ME003	MALF_ANALOG
MALF_ME004	MALF_ANALOG
MALF_ME005	MALF_ANALOG
MALF_ME006	MALF_DIGITAL
MALF_ME007	MALF_DIGITAL

Appendix A2

A 2.1 Pressure drop and pressure node calculation in NHW network

Total pressure drop = 46.5m elevation head

$$= \rho g h$$

$$= 992.3 \times 9.81 \times 46.5$$

$$= 452.65 \text{ kPa}$$

Assumed pressure drop in valve = 20 kPa

pressure drop in pipe per meter = (452.65-20)/42 = 10.3 kPa

NHW_X01 node pressure = 101.3 kPa

NHW_N01 node pressure = 101.3+ $\rho g h$ -10.3x6

$$= 101.3 + 9.81 \times 992.3 \times 10.5 - 61.8$$

$$= 141.7 \text{ kPa}$$

NHW_X02 node pressure = 141.7 + $\rho g h$ -20-36x10.3

$$= 141.7 + 9.81 \times 992.3 \times 36 - 390.8$$

$$= 101.3 \text{ kPa}$$

A 2.2 Pressure drop and pressure node calculation in NHI and NHJ network

In normal condition, pressure at NHI_X01 and NHJ_X01 is 200 kPa

assumed pressure drop in pipe = 10 kPa

NHI_N03 and NHJ_N03 node pressure = ρgh + 200 -10

$$= 992.3 \times 9.81 \times 13.6 + 190$$

$$= 322.39 \text{ kPa}$$

NHI_N04 and NHJ_N04 node pressure = ρgh + 322.39 - 10

$$= 992.3 \times 9.81 \times 3 + 312.39$$

$$= 341.59 \text{ kPa}$$

A 2.3 Pressure drop and pressure node calculation in NHR network

Assumed pressure drop in valve = 20 kPa

pressure drop in pipe = 10 kPa

NHR_X01 = NHR_X02 = NHR_X03 = NHR_XO4 = 101.3 kPa

NHR_N01 node pressure = 101.3 + ρgh - 20 -10

$$= 71.3 + 992.3 \times 9.81 \times 2$$

$$= 90.77 \text{ kPa}$$

assumed pressure drop in pump = 30 kPa

Pump head = ρgh

$\quad = 992.3 \times 9.81 \times 100$

$\quad = 973.45$ kPa

NHR_N05 node pressure = 90.77 + 973.45 -30

$\quad = 1034.22$ kPa

NHRN05_N10 pressure drop = 223.89 kPa

From specifications, heat exchanger pressure drop = 95.6 kPa

NHRN05_N09 pressure drop = 223.89 - 95.6 = 128.29 kPa

NHR_N05 node pressure = 1034.22- ρgh -128.29

$\quad = 905.93 - 992.3 \times 9.81 \times 10$

$\quad = 808.59$ kPa

NHR_N10 node pressure = 808.59 - ρgh -95.6

$\quad = 712.99 - 992.3 \times 9.81 \times 2$

$\quad = 693.52$ kPa

pressure drop from NHR_N10 to header = 107.08 - 20

$\quad = 87.08$ kPa

pressure drop in NHRN10_N15,NHRN15_N16 = 29.03 kPa

NHR_N15 node pressure = 693.52 - ρgh - 29.03

$$= 664.49 - 992.3 \times 9.81 \times 2$$

$$= 645.02 \text{ kPa}$$

NHR_N16 node pressure = 645.02 - ρgh - 29.03 - 20

$$= 615.99 - 992.3 \times 9.81 \times 6 - 20$$

$$= 537.58 \text{ kPa}$$

assumed pressure drop in valve = 20 kPa

NHRN10_N20 pressure drop = 610.35 - 40

$$= 570.35 \text{ kPa}$$

assumed NHRN10_N13_1 pressure drop = 72.4 kPa

NHR_N13 node pressure = 693.52 - 72.4 - 20

$$= 601.12 \text{ kPa}$$

NHRN13_N20 pressure drop = 570.35 - 60

$$= 510.35 \text{ kPa}$$

NHR_N20 node pressure = 601.12 - 510.35

$$= 90.77 \text{ kPa}$$

Appendix A3

A 3.1 Algorithm 850 for Neutronic modeling

SUBROUTINE ALG850(INP,OUT,COF,DT)

```
C AUTHOR:C.MUNCHAROEN
C
C DATE:24-JUN-97
C
C REVISION NOTES:
C ALGORITHM NUMBER:850
C
C ALGORITHM NAME: POWER_CHANGE
C
C ALGORITHM DESC: POWER CHANGE DUE TO DELTA_K
C
C INPUTS:2
C
C INP(1)=PI,INITAIL POWER(MW)
C INP(2)=DELTA_K,REACTIVITY(K)
C
C------------------------------------------------
.C
C OUTPUTS:1
C
C OUT(1)=PO,FINAL POWER(MW)
C
C------------------------------------------------
C
C COEFFICIENTS:3
C
C COF(1)=NL,NEUTRON LIFETIME(SEC)
C COF(2)=AL,AVERAGE LIFETIME(SEC)
C COF(3)=PNL,PROMPT NEUTRON LIFETIME(SEC)
C------------------------------------------------
C
C DECLARATIONS
C
      IMPLICIT NONE
```

```fortran
C
      DOUBLE PRECISION INP(*),OUT(*),COF(*),DT
      DOUBLE PRECISION PI,DELTA_K,PO,NL,AL,PNL
C
C INPUTS,OUTPUTS,AND COFS SETUP
C
      PI=INP(1)
      DELTA_K=INP(2)


C
      PO=OUT(1)

C
      NL=COF(1)
      AL=COF(2)
      PNL=COF(3)


C
C-----------------------------------------------
C
C MAIN PROGRAM BEGINS
C
C THIS IS THE PROGRAM TO SIMULATE THE FUNCTION
C OF POWER CHANGE DUE TO THE EFFECT OF REACTIVITY
C CHANGE
C
C----FINAL POWER CALCULATION
C
      PO=PI*((NL/(NL-DELTA_K))*EXP((DELTA_K/(AL*(NL-DELTA_K)))*DT)
     & -((DELTA_K/(NL-DELTA_K))*EXP((-(NL-DELTA_K)/PNL)*DT)))+0.00001
C
      OUT(1)=PO

C
      RETURN
      END
```

A 3.2 Algorithm 853 for Thermalhydraulic modeling

```fortran
      SUBROUTINE ALG853(INP,OUT,COF,DT)
```

```
C AUTHOR:C.MUNCHAROEN
C
C DATE:30-JUN-97
C
C REVISION NOTES:
C
C ALGORITHM NUMBER:853
C
C ALGORITHM NAME:FUEL_TEMP
C
C ALGORITHM DESC:AVERAGE FUEL TEMPERATURE IN EACH CHANNEL
C
C INPUTS:10
C INP(1)=DENF,DENSITY OF FUEL,Kg/M3
C INP(2)=CPF,SPECIFIC HEAT CAPACITY OF FUEL,KJ/Kg/DEGREE C
C INP(3)=KF,THERMAL CONDUCTIVITY OF FUEL,KJ/sec/M/DEGREE C
C INP(4)=MF,MASS OF FUEL IN 1 CHANNEL,Kg
C INP(5)=HFC,HEAT TRANSFER COEFFICIENT FROM FUEL TO
COOLANT,KJ/sec/DEGREE C
C INP(6)=Q,THERMAL POWER DELIVERED TO COOLANT,KJ/sec
C INP(7)=TRC(1),AVERAGE TEMPERATURE OF COOLANT IN CHANNEL
1,DEGREE C
C INP(8)=TRC(2),AVERAGE TEMPERATURE OF COOLANT IN CHANNEL
2,DEGREE C
C INP(9)=TRC(3),AVERAGE TEMPERATURE OF COOLANT IN CHANNEL
3,DEGREE C
C INP(10)=TRC(4),AVERAGE TEMPERATURE OF COOLANT IN CHANNEL
4,DEGREE C
C
C
C OUTPUTS:14
C OUT(1)=TAV(1),AVERAGE FUEL TEMPERATURE IN CHANNEL 1,DEGREE C
C OUT(2)=TAV(2),AVERAGE FUEL TEMPERATURE IN CHANNEL 2,DEGREE C
C OUT(3)=TAV(3),AVERAGE FUEL TEMPERATURE IN CHANNEL 3,DEGREE C
C OUT(4)=TAV(4),AVERAGE FUEL TEMPERATURE IN CHANNEL 4,DEGREE C
C OUT(5)=TAVE,AVERAGE FUEK TEMPERATURE,DEGREE C
C OUT(6)=TSA(1),FUEL SHEATH TEMPERATURE IN CHANNEL 1,DEGREE C
C OUT(7)=TSA(2),FUEL SHEATH TEMPERATURE IN CHANNEL 2,DEGREE C
C OUT(8)=TSA(3),FUEL SHEATH TEMPERATURE IN CHANNEL 3,DEGREE C
C OUT(9)=TSA(4),FUEL SHEATH TEMPERATURE IN CHANNEL 4,DEGREE C
C OUT(10)=TSAE,AVERAGER FUEL SHEATH TEMPERATURE IN
CORE,DEGREE C
C OUT(11)=QRA(1),HEAT TRANSFER TO COOLANT IN CHANNEL 1,KJ/sec
C OUT(12)=QRA(2),HEAT TRANSFER TO COOLANT IN CHANNEL 2,KJ/sec
C OUT(13)=QRA(3),HEAT TRANSFER TO COOLANT IN CHANNEL 3,KJ/sec
```

```
C OUT(14)=QRA(4),HEAT TRANSFER TO COOLANT IN CHANNEL 4,KJ/sec
C
C COEFFICIENT:3
C COF(1)=DIAF,DIAMETER OF FUEL ELEMENT,M
C COF(2)=FRACTION,FRACTION OF POWER DELIVERED TO COOLANT IN 1
CHANNEL,NORM
C COF(3)=AF,TOTAL FUEL CHANNEL HEAT TRANSFER AREA,m2
C
C DECLARATION
        IMPLICIT NONE
C
        INTEGER I
        DOUBLE PRECISION INP(*),OUT(*),COF(*),DT
        DOUBLE PRECISION DENF,CPF,KF,MF,HFC,Q
        DOUBLE PRECISION TRC(4),QRA(4)
        DOUBLE PRECISION TAV(4),TAVE,TSA(4),TSAE,AF
        DOUBLE PRECISION DIAF,FRACTION,TC(4),A(4),B(4),C(4)
C
C INPUTS,OUTPUTS, COFS SETUP
C
        DENF=INP(1)
        CPF=INP(2)
        KF=INP(3)
        MF=INP(4)
        HFC=INP(5)
        Q=INP(6)
        TRC(1)=INP(7)
        TRC(2)=INP(8)
        TRC(3)=INP(9)
        TRC(4)=INP(10)
C
        TAV(1)=OUT(1)
        TAV(2)=OUT(2)
        TAV(3)=OUT(3)
        TAV(4)=OUT(4)
        TAVE=OUT(5)
        TSA(1)=OUT(6)
        TSA(2)=OUT(7)
        TSA(3)=OUT(8)
        TSA(4)=OUT(9)
        TSAE=OUT(10)
        QRA(1)=OUT(11)
        QRA(2)=OUT(12)
        QRA(3)=OUT(13)
        QRA(4)=OUT(14)
```

```
C
        DIAF=COF(1)
        FRACTION=COF(2)
        AF=COF(3)
C
C MAIN PROGRAM BEGINS
C
C THIS IS THE PROGRAM TO CALCULATE AVERAGE FUEL TEMPERATURE
C AFTER REACTOR SHUTDOWN
C
C --------CALCULATE TIME CONSTANT FOR FUEL
        DO 1 I=1,4
        TC(I)=DIAF**2*DENF*CPF/32/KF
1          CONTINUE

C---------CALCULATE THE FIRST TERM IN THE EQUATION,A
        DO 2 I=1,4
        A(I)=DT*Q*FRACTION/MF/CPF
2          CONTINUE

C---------CALCULATE THE SECOND TERM IN THE EQUATION,B
        DO 3 I=1,4
        B(I)=DT*HFC*DIAF*TRC(I)/TC(I)/(HFC*DIAF+8*KF)
3          CONTINUE

C---------CALCULATE THE THIRD TERM IN THE EQUATION,C
        DO 4 I=1,4
        C(I)=1+DT/TC(I)-DT*8*KF/TC(I)/(HFC*DIAF+8*KF)
4          CONTINUE

C---------CALCULATE FUEL TEMPERATURE IN CHANNEL I (I=1,2,3,4)
        DO 5 I=1,4
        TAV(I)=(TAV(I)+A(I)+B(I))/C(I)

5          CONTINUE

C---------CALCULATE AVERAGE FUEL TEMPERATURE IN CORE
        TAVE=(TAV(1)+TAV(2)+TAV(3)+TAV(4))/4

C---------CALCIULATE FUEL SHEATH TEMPERATURE IN CHANNEL I(I=1,2,3,4)
        DO 6 I=1,4
        TSA(I)=((8*KF*TAV(I))+(HFC*DIAF*TRC(I)))/(HFC*DIAF+8*KF)
6          CONTINUE

C---------CALCULATE AVERAGE FUEL SHEATH TEMPERATURE IN CORE
```

```
         TSAE=(TSA(1)+TSA(2)+TSA(3)+TSA(4))/4

C---------CALCULATE HEAT TRANSFER TO COOLANT EACH CHANNEL
C
         DO 7 I=1,4
         QRA(I)=HFC*AF*(TSA(I)-TRC(I))
7        CONTINUE

C OUTPUTS SETUP
         OUT(1)=TAV(1)
         OUT(2)=TAV(2)
         OUT(3)=TAV(3)
         OUT(4)=TAV(4)
         OUT(5)=TAVE
         OUT(6)=TSA(1)
         OUT(7)=TSA(2)
         OUT(8)=TSA(3)
         OUT(9)=TSA(4)
         OUT(10)=TSAE
         OUT(11)=QRA(1)
         OUT(12)=QRA(2)
         OUT(13)=QRA(3)
         OUT(14)=QRA(4)
C
         RETURN
         END
```
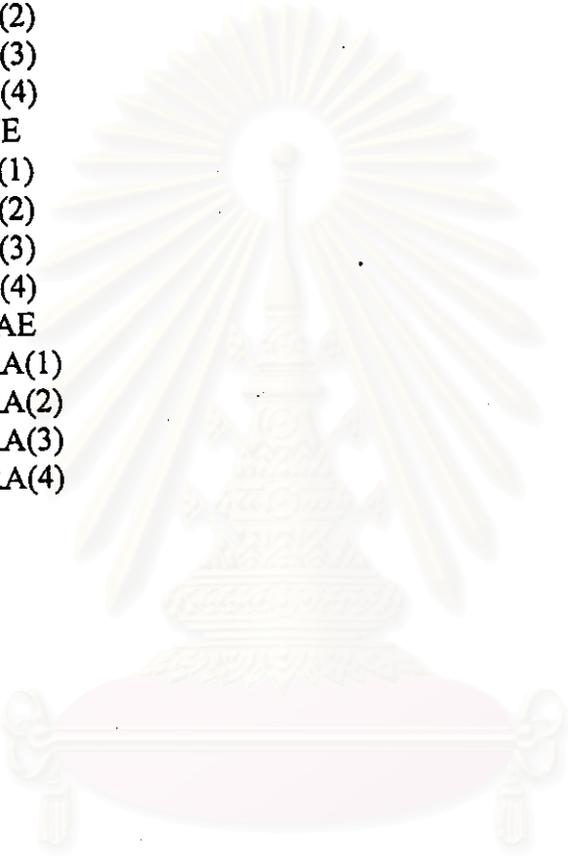
About Author

Mr. Chaiwat Muncharoen was born on 19 April 1970 in Lampang province. He got bachelor degree in Mechanical Engineering from Chulalongkorn University in 1992. After that he worked for Pipeline company as Project Engineer for 2 years. In 1995, he started to work with SNB consultant company as Mechanical Engineer. At the same time, he joined the course in master degree in Department of Nuclear Technology, Faculty of Engineering, Chulalongkorn University.