行政院及所屬各機關出國報告

（出國類別：實習）

核能四廠模擬器硬體維護人員後續訓練

服務機關：台灣電力公司

出國人 職　　稱：電腦軟體工程監、儀電工程師、儀電工程師

姓　　名：張勳智、林輝燦、鄭清河

出國地區：美國

出國日期：91.10.9～91.11.27

報告日期：91.12.25

行政院及所屬各機關出國報告提要

C09105147

出國報告名稱： 核能四廠模擬器硬體維護人員後續訓練

頁數 79 含附件：□是■否

出國計畫主辦機關/聯絡人/電話：台灣電力公司/陳德隆/(02)2366-7685

出國人員姓名/服務機關/單位/職稱/電話：

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鄭清河/台灣電力公司/龍門施工處/儀電工程師/(02)2490-2401 轉分機：2364

出國類別：□1 考察□2 進修□3 研究■4 實習□5 其他

出國期間：91.10.09～91.11.27　　出國地區：美國

報告日期：91.12.25

分類號/目：

關鍵詞：核能電廠　模擬器

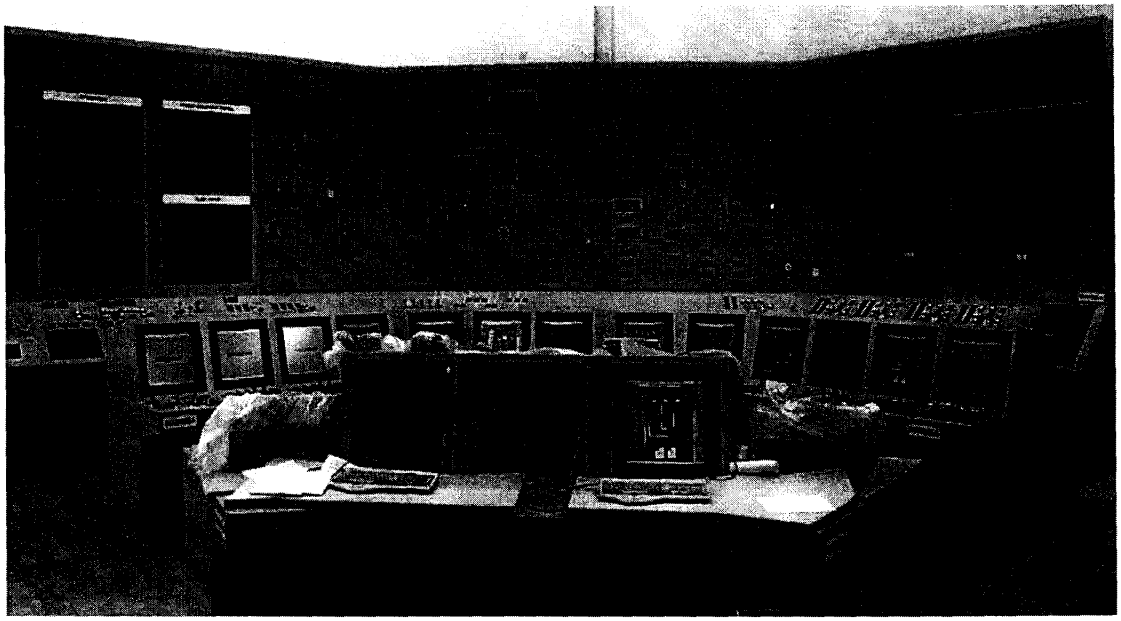
內容摘要：(二百至三百字)

本項出國緣起依龍門計畫採購合約赴廠家學習核四廠模擬器硬體之維護技術訓練，本公司派遣第二批核四運轉維護技術幹部模擬器硬體維護組人員共三人，赴廠家接受訓練，以全盤了解模擬器硬體系統架構、設計、除錯、安裝、修改、更新、維護等相關技術環節，並經由實作熟悉相關細部技術，奠定將來驗收及進行模擬器驗證之能力與建立將來自行執行模擬器硬體維護及更新之能力。本次訓練為繼續89年因政府宣布核四暫停興建而中斷之訓練。本報告即為此小組接受該項訓練後撰寫之出國報告，內容涵蓋出國目的、出國行程、受訓內容及心得、建議事項等內容。

目　錄

核四廠模擬器硬體維護後續訓練

SIMULATOR HARDWARE TRAINING



壹、出國目的

依合約赴廠家學習核四廠模擬器硬體之設計及維護技術訓練，以全盤了解模擬器硬體系統架構、設計、除錯、安裝、修改、更新、維護等相關技術環節，並經由實作熟悉相關細部技術，奠定將來驗收及進行模擬器驗證之能力與建立將來自行執行模擬器硬體維護及更新之能力。本次訓練是爲延續前因政府宣佈核四停建而中斷之訓練，重點放在工作訓練，由於模擬器正值安裝測試階段，藉由實作學習模擬器硬體維護相關技術累積工作經驗，期爲爾後核能四廠模擬器硬體維護工作奠定基礎。

貳、出國行程及訓練課程

出國行程:

10/09/2002	啓程	台北->聖荷西
10/10/2002~11/25/2002	核能四廠模擬器硬體維護人員後續訓練	GE公司
11/26/2002~11/27/2002	返程	聖荷西->台北

本次訓練主要內容爲On Job Training，主要重點有:

一、瞭解核四模擬器硬體架構。
二、瞭解核四模擬器硬體各種設備及其內部的組成元件。
三、根據K-2000 Schematic Diagrams 核對Wide Display Panel, Main Control Console 盤面接線。
四、與GE工程設計人員一起工作，利用Foxboro I/A軟體修改Class 1E (Eaton/DRS)操作畫面上的Navigation Button 操作邏輯，以正確引導運轉員操作程序。
五、練習安裝與拆卸控制盤面上之元件。拆解Mimic Tile，了解控制板組成，LED及維護方式。
六、和GE PCS 設計負責人追蹤修訂Foxboro與STN 相關之POINTS ID'S 資料。
七、與Foxboro, GE人員在Simulator做系統整合測試, 如 Historian System Testing，Alarm & Annunciator， Mimic display…。
八、收集STN設備，Foxboro AOS(Application Object Service) Manual等維護資料。
九、在STN工作站練習每日測試(DORT， Daily Operation Readiness Test) 。
十、預先執行驗收測試ATP01及ATP02測試程序書部份內容。

參、受訓內容及心得

一. 模擬器系統架構

A. 核四廠模擬器硬體架構

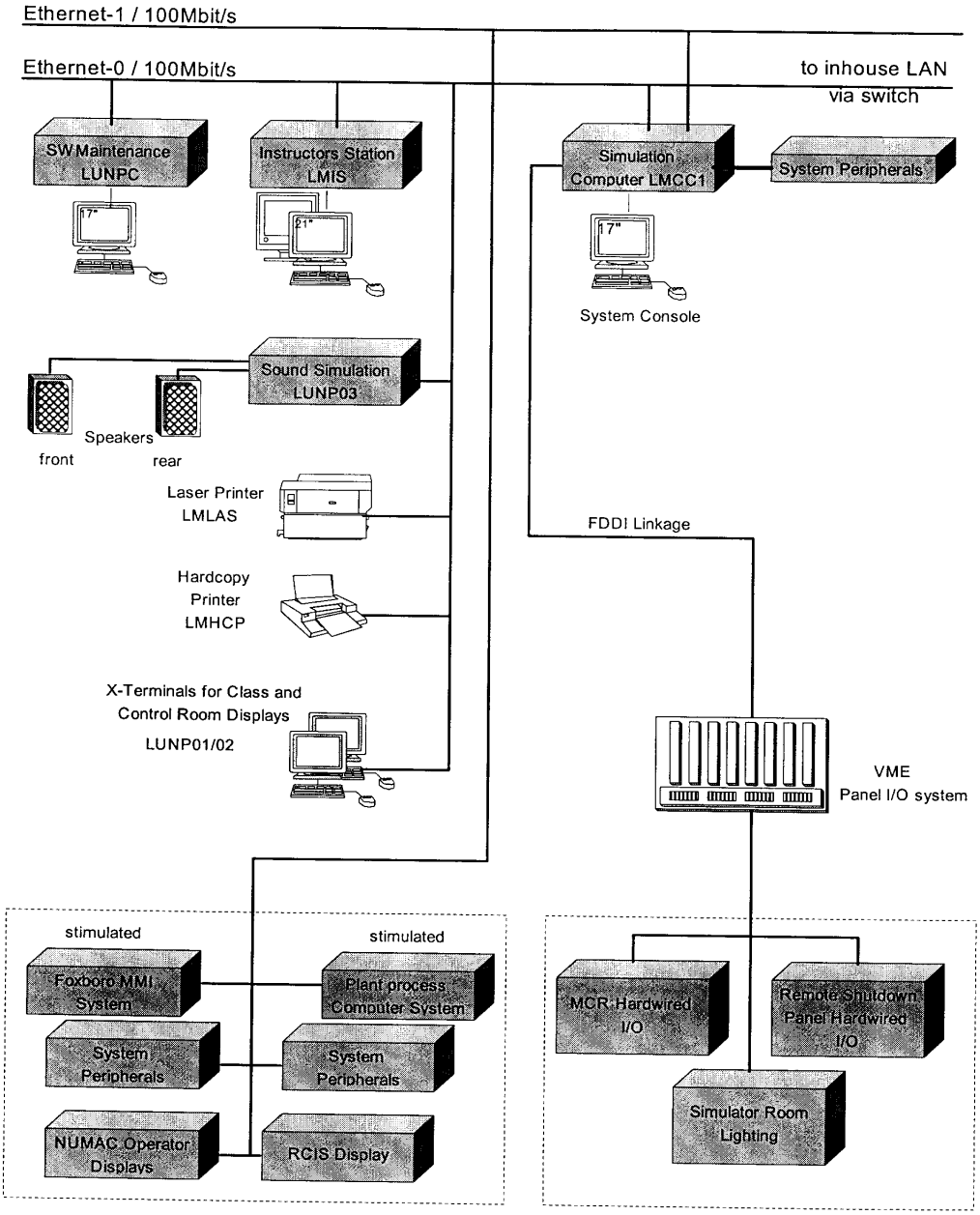
核四廠模擬器系統是由奇異公司(GE) 統包， 系統軟體部份則由 STN ATLAS 負責， 控制盤由 INABENSA 製造， MIMIC 顯示幕由 SACO 負責， DCIS/MMI/PCS 操作畫面大部份由 FOXBORO 公司負責， GE 負責整合。模擬器系統架構圖如圖一所示，所有電腦設備均以 LAN 網路線連接。在控制盤方面之佈置則如附錄一 K2000 圖所示

模擬器系統主要元件包含：

- 1 x Simulation Computer (LMCC1)
- 1 x Instructor-Station (LMIS)
- 1 x PDM Workstation (LMPDM)
- 1 x 1PTS Workstation (LMPTS1)
- 1 x Software Maintenance Station (LUNPC)
- 1 x PC for Sound Simulation (LUNP03)
- 1 x Laser Printer (LMLAS)
- 1 x Plotting Device (LMHCP)
- 1 x Data I/O-System (LMIOS)
- 1 x Hub 16 Port, Fast Ethernet 100 Mbit/s, auto sensing
- 2 x PC with X-Terminal capability for Control Room and Class Room Displays (LUNP01/02)
- 1 x Foxboro System incl. All application processors and I/O clients
- 1 x Hub 12 Port, Fast Ethernet 10/100 Mbit/s, Connect the Foxboro HW
- 2 x Speakers for sound simulation connectable to PC sound card
- 1 x Relay to room lighting for light simulation

模擬器電腦系統 STN 提供之設備，其 IP 定址如下:

```
127.0.0.1              localhost  loopback
# First Ethernet
141.200.132.1    lunpc01 LUNPC01          # Seminarroom-PC for Lungmen (SuSE Linux
141.200.132.2    lunpc02 LUNPC02          # Seminarroom-PC for Lungmen (SuSE Linux
141.200.132.3    lunpc03 LUNPC03          # Sound-PC for Lungmen (SuSE Linux)
#141.200.132.4   lunpc   LUNPC            # Lungmen Master PC (Windows-NT)
141.200.132.4    lungmenlab      LUNGMENLAB              # Lungmen Master PC (Win
141.200.132.8    hpdj1600                 # HP DeskJet 1600CM
#141.200.132.101 hpdj1600                 # HP DeskJet 1600CM
141.200.132.9    lmlas LMLAS              # Lungmen Laser Printer LN17ps
141.200.132.10   lmcc1 LMCC1              # Lungmen AlphaServer ES-40 4/833 Ether
141.200.132.11   lmis  LMIS               # Lungmen DEC PWS433a ether 0
141.200.132.20   lmpdm LMPDM              # Lungmen AlphaServer DS20 5/500
141.200.132.21   lmpts1 LMPTS1 gets GETS  # Lungmen AlphaServer DS20 5/500
141.200.132.31   tsat01  TSAT01           # PC for LUNGMEN
141.200.132.32   tsat02  TSAT02           # PC for LUNGMEN
141.200.132.40   lmpts2 LMPTS2            # Lungmen AlphaServer DS20 5/500
# Second Ethernet
141.200.133.20   lmcc11  LMCC11           # Lungmen AlphaServer ES-40 4/833 Ether
141.200.133.51   lmfoxws1 LMFOXWS1        # Foxboro Workstation #1 S91055 Non IE
141.200.133.52   lmfoxws2 LMFOXWS2        # Foxboro Workstation #2 S91056 Non IE
141.200.133.53   lmfoxws3 LMFOXWS3        # Foxboro Workstation #3 S91050 Non IE
141.200.133.54   lmfoxws4 LMFOXWS4        # Foxboro Workstation #4 S91051 Non IE
141.200.133.55   lmfoxws5 LMFOXWS5        # Foxboro Workstation #5 S91052 Non IE
141.200.133.56   lmfoxws6 LMFOXWS6        # Foxboro Workstation #6 S91053 IE
141.200.133.57   lmfoxws7 LMFOXWS7        # Foxboro Workstation #7 S74050 IE
# FDDI Net
141.100.132.70   fddifta0
141.100.132.72   drtpsim DRTPSIM          # RTP central controller
# Temporary
141.200.10.56    p056  P056               # GLCAD Test PC (SuSE Linux)
141.200.132.100 lunp03                    # PRA-Alarm Monitor (WinNT)
```


Ethernet-1 / 100Mbit/s
Ethernet-0 / 100Mbit/s
to inhouse LAN
via switch
SW Maintenance LUNPC
Instructors Station LMIS
Simulation Computer LMCC1
System Peripherals
17"
21"
17"
System Console
Sound Simulation LUNP03
Speakers
front
rear
Laser Printer LMLAS
FDDI Linkage
Hardcopy Printer LMHCP
X-Terminals for Class and Control Room Displays LUNP01/02
VME Panel I/O system
stimulated
stimulated
Foxboro MMI System
Plant process Computer System
System Peripherals
System Peripherals
NUMAC Operator Displays
RCIS Display
MCR Hardwired I/O
Remote Shutdown Panel Hardwired I/O
Simulator Room Lighting
provided by GE/Foxboro
provided by GE/Foxboro
Ethernet-0 - 16 Port 10/100 Mbit/s auto sensing Hub
Ethernet-1 - 8 Port 10/100Mbit/sHub

圖一. 模擬器系統架構圖

二. 硬體維修及工作訓練重點

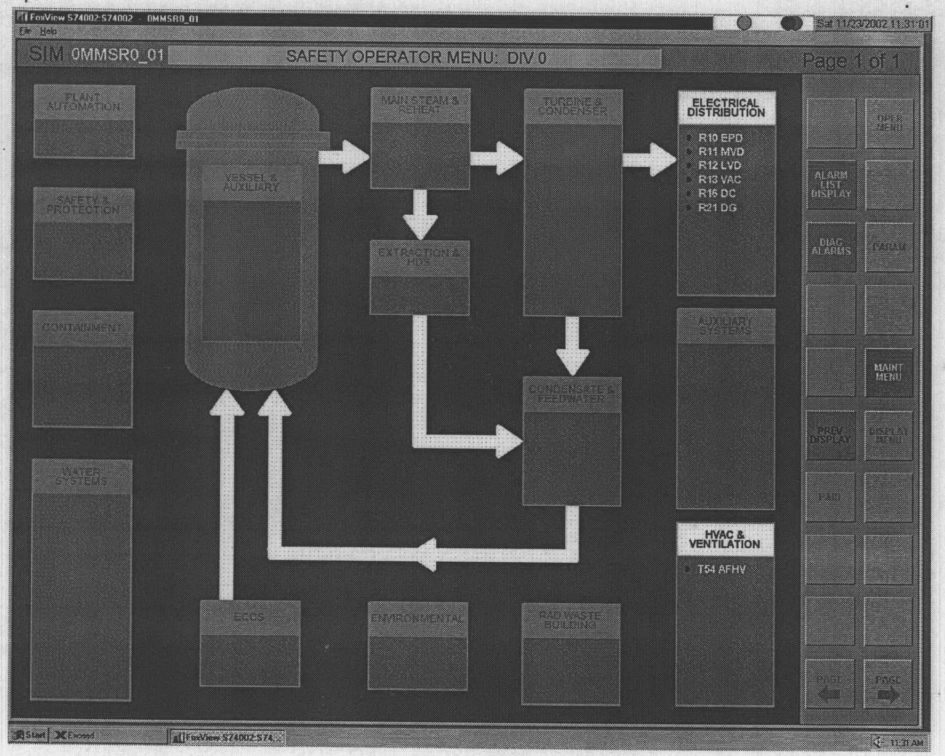
模擬器硬體維修及工作訓練(On Job Training)

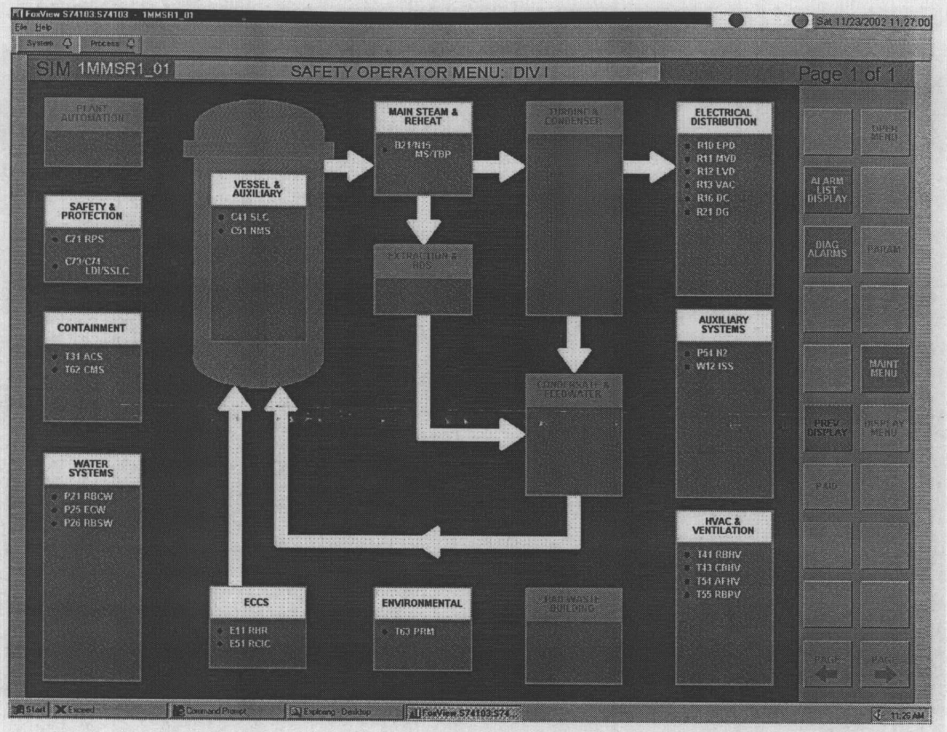
由於在受訓期間，核四廠模擬器設備正在做整合測試，因此利用 Simulator 做爲上課、維修練習及 OJT 實習的器具。

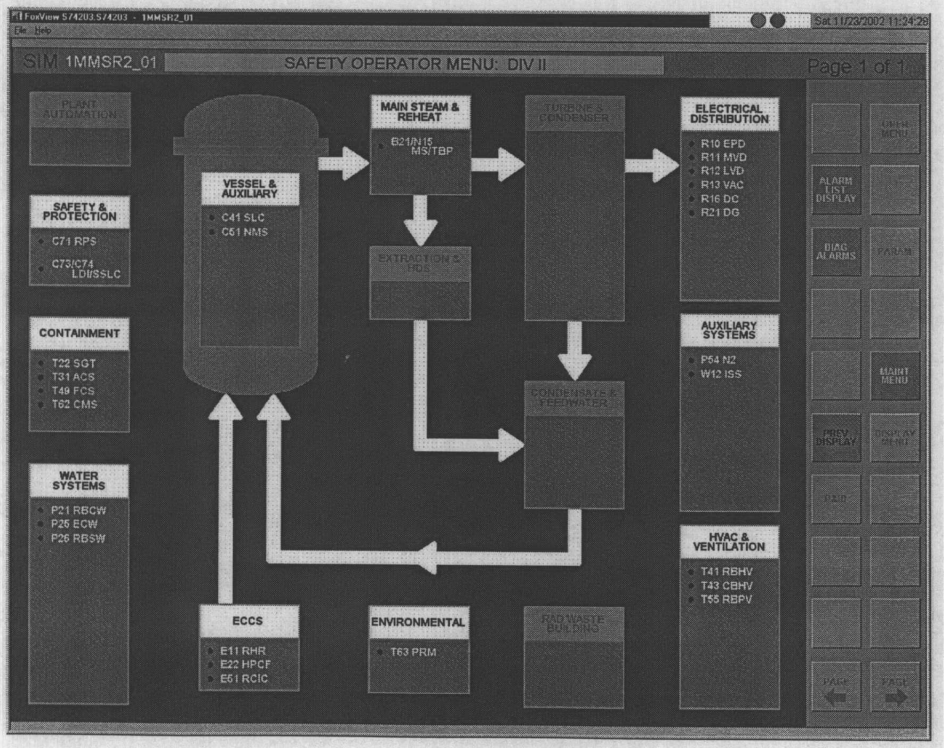
工作訓練的重點則在複習基礎課程，練習電腦設備維護的技能，熟悉介面設計，瞭解控制盤內部接線及審查相關設計圖面和確定預製電纜線的長度。並與 Foxboro, GE 人員在 Simulator 做系統整合測試。

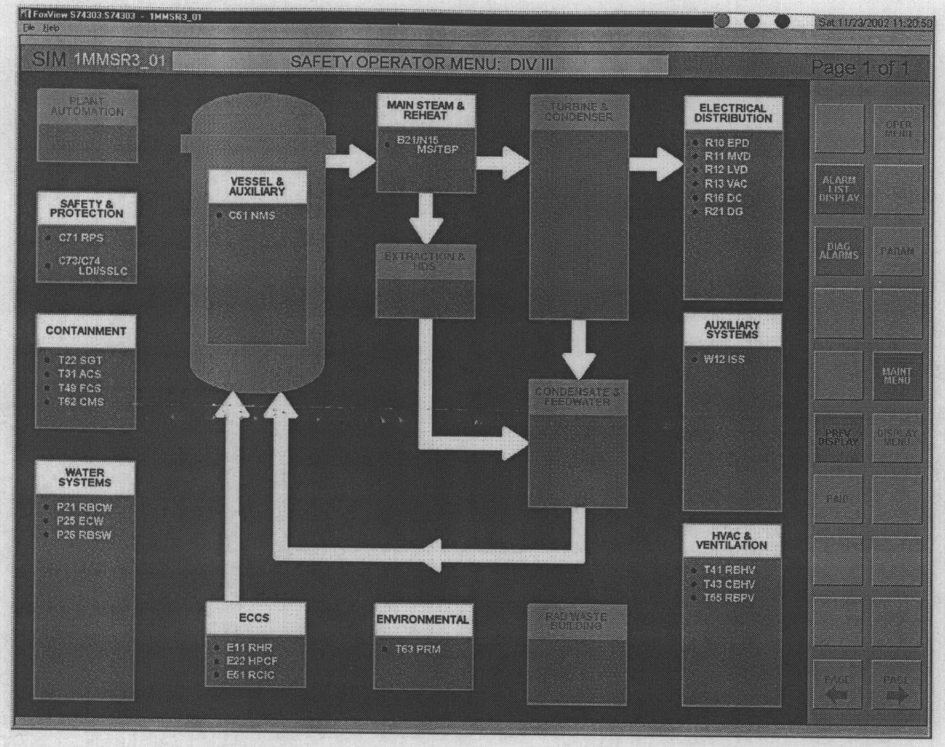
I. 主控制室運轉員操作畫面

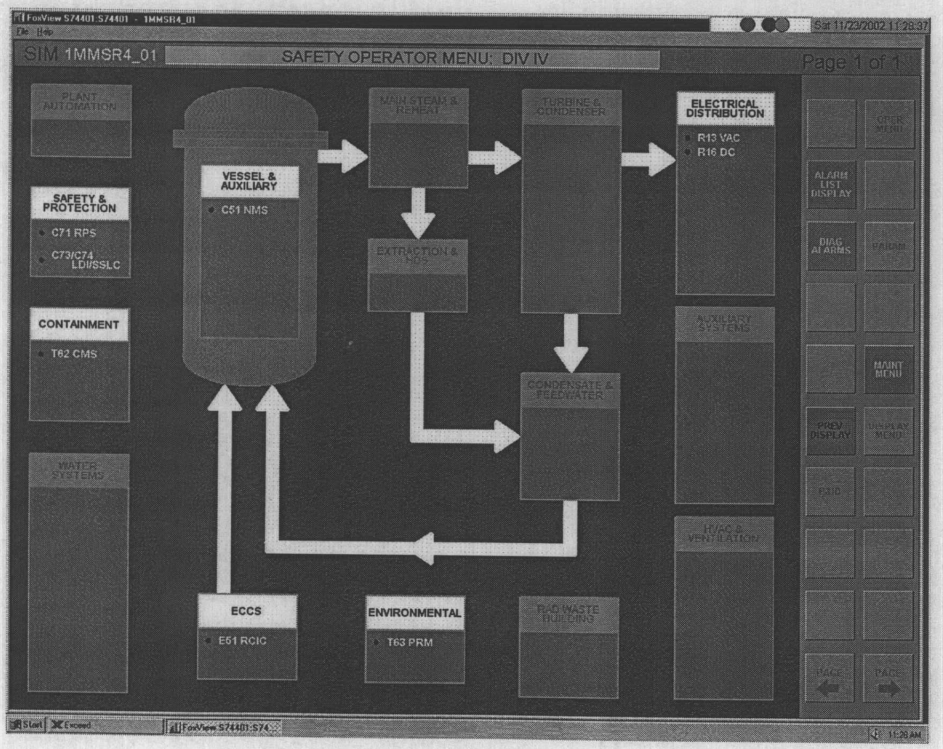
主控制室運轉員操作畫面，可劃分成 1E 及 Non E，1E 部分又分 DIV 1，DIV 2，DIV 3，DIV 4 及 DIV 0，其操作主畫面如下圖所示：

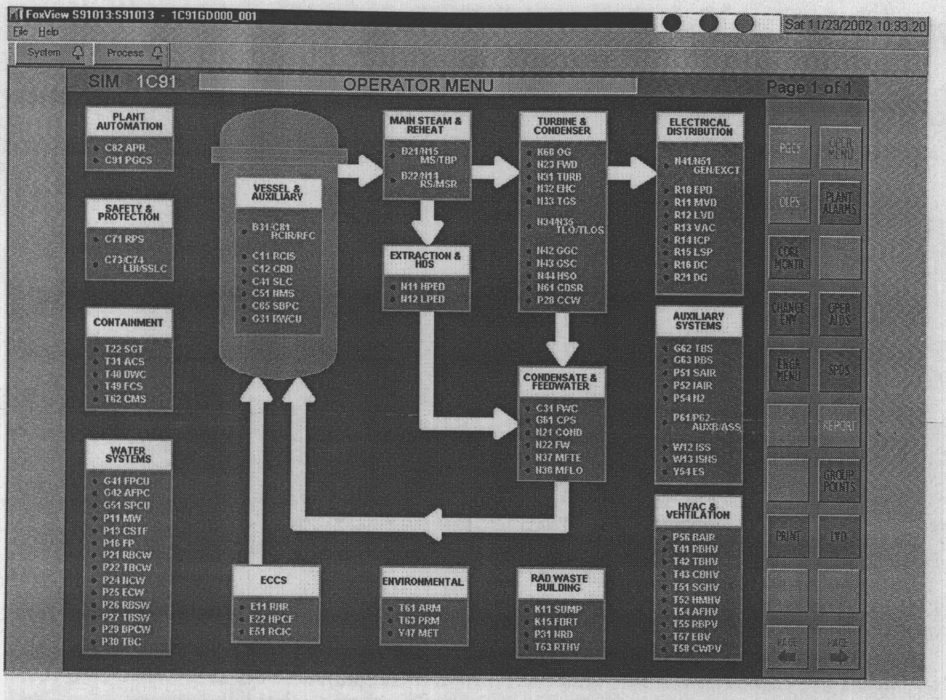


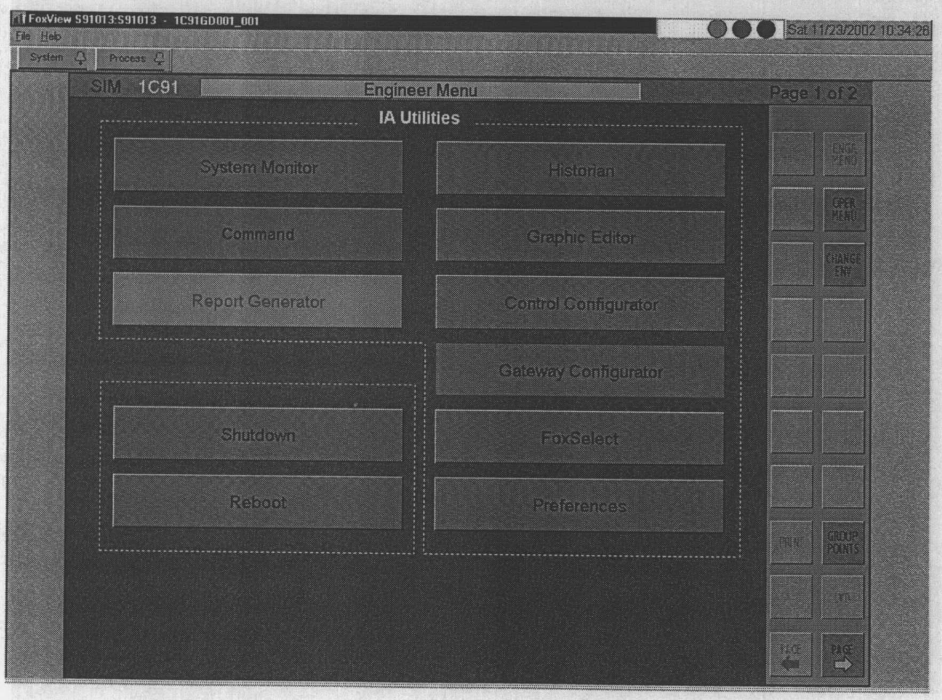

SIM 1MMSR1_01
SAFETY OPERATOR MENU: DIV I
Page 1 of 1
PLANT AUTOMATION
VESSEL & AUXILIARY
C41 SLC
C61 NMS
MAIN STEAM & REHEAT
B21/N15 MS/TBP
TURBINE & CONDENSER
ELECTRICAL DISTRIBUTION
R10 EPD
R11 MVD
R12 LVD
R13 VAC
R16 DC
R21 DG
SAFETY & PROTECTION
C71 RPS
C73/C74 LDI/SSLC
EXTRACTION & FDS
CONDENSATE & FEEDWATER
AUXILIARY SYSTEMS
P54 N2
W12 ISS
CONTAINMENT
T31 ACS
T62 CMS
WATER SYSTEMS
P21 RBCW
P25 ECW
P26 RBSW
HVAC & VENTILATION
T41 RBHV
T43 CBHV
T51 AFHV
T55 RBPV
ECCS
E11 RHR
E51 RCIC
ENVIRONMENTAL
T63 PRM
RAD WASTE BUILDING
ALARM LIST DISPLAY
DIAG ALARMS
MAINT MENU
PREV DISPLAY
PAGE


SIM 1MMSR2_01
SAFETY OPERATOR MENU: DIV II
Page 1 of 1
PLANT AUTOMATION
VESSEL & AUXILIARY
C41 SLC
C61 NMS
MAIN STEAM & REHEAT
B21/N15 MS/TBP
TURBINE & CONDENSER
ELECTRICAL DISTRIBUTION
R10 EPD
R11 MVD
R12 LVD
R13 VAC
R16 DC
R21 DG
SAFETY & PROTECTION
C71 RPS
C73/C74 LDI/SSLC
EXTRACTION & FDS
CONDENSATE & FEEDWATER
AUXILIARY SYSTEMS
P54 N2
W12 ISS
CONTAINMENT
T22 SGT
T31 ACS
T49 FCS
T62 CMS
WATER SYSTEMS
P21 RBCW
P25 ECW
P26 RBSW
HVAC & VENTILATION
T41 RBHV
T43 CBHV
T55 RBPV
ECCS
E11 RHR
E22 HPCF
E61 RCIC
ENVIRONMENTAL
T63 PRM
RAD WASTE BUILDING
ALARM LIST DISPLAY
DIAG ALARMS
MAINT MENU
PREV DISPLAY
PAGE


SIM 1MMSR3_01
SAFETY OPERATOR MENU: DIV III
Page 1 of 1
PLANT AUTOMATION
SAFETY & PROTECTION
C71 RPS
C73/C74 LDI/SSLC
CONTAINMENT
T22 SGT
T31 ACS
T49 FCS
T62 CMS
WATER SYSTEMS
P21 RBCW
P25 ECW
P26 RBSW
VESSEL & AUXILIARY
C51 NMS
MAIN STEAM & REHEAT
B21/N15 MS/TBP
EXTRACTION & HDS
TURBINE & CONDENSER
CONDENSATE & FEEDWATER
ELECTRICAL DISTRIBUTION
R10 EPD
R11 MVD
R12 LVD
R13 VAC
R16 DC
R21 DG
AUXILIARY SYSTEMS
W12 ISS
HVAC & VENTILATION
T41 RBHV
T43 CBHV
T55 REPV
ECCS
E11 RHR
E22 HPCF
E51 RCIC
ENVIRONMENTAL
T63 PRM
RAD WASTE BUILDING
ALARM LIST DISPLAY
DIAG ALARMS
MAINT MENU
PREV DISPLAY
PAGE

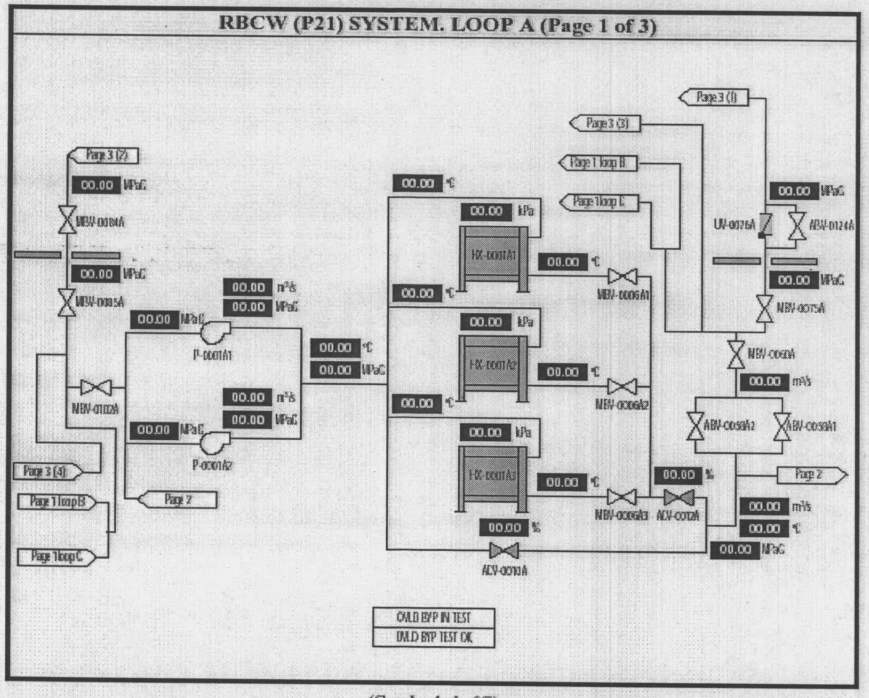

SIM 1MMSR4_01
SAFETY OPERATOR MENU: DIV IV
Page 1 of 1
PLANT AUTOMATION
SAFETY & PROTECTION
C71 RPS
C73/C74 LDI/SSLC
CONTAINMENT
T62 CMS
WATER SYSTEMS
VESSEL & AUXILIARY
C51 NMS
MAIN STEAM & REHEAT
EXTRACTION & HDS
TURBINE & CONDENSER
CONDENSATE & FEEDWATER
ELECTRICAL DISTRIBUTION
R13 VAC
R16 DC
AUXILIARY SYSTEMS
HVAC & VENTILATION
ECCS
E51 RCIC
ENVIRONMENTAL
T63 PRM
RAD WASTE BUILDING
ALARM LIST DISPLAY
DIAG ALARMS
MAINT MENU
PREV DISPLAY
PAGE


FoxView S91013:S91013 - 1C91GD000_001
Sat 11/23/2002 10:33:20
File Help
System
Process
SIM 1C91
OPERATOR MENU
Page 1 of 1
PLANT AUTOMATION
C82 APR
C91 PGCS
SAFETY & PROTECTION
C71 RPS
C73/C74 LBSSLC
CONTAINMENT
T22 SGT
T31 ACS
T40 DWC
T49 FCS
T62 CMS
WATER SYSTEMS
G41 FPCU
G42 AFPC
G51 SPCU
P11 MW
P13 CSTF
P16 FP
P21 RBCW
P22 TBCW
P24 HCW
P25 ECW
P26 RBSW
P27 TBSW
P29 BPCW
P30 TBC
VESSEL & AUXILIARY
B31 CR1 RCIR/RFC
C11 RCIS
C12 CRD
C41 SLC
C51 HMS
C65 SBPC
G31 RWCU
MAIN STEAM & REHEAT
B21/M15 MS/TBP
B22/M11 RS/MSR
EXTRACTION & HDS
M11 HPED
M12 LPED
TURBINE & CONDENSER
K68 OG
N23 FWD
N31 TDRB
N32 EHC
N33 TGS
N34/N35 TLO/TLOS
N42 GGC
N43 GSC
N44 HSO
N61 CDSR
P28 CCW
ELECTRICAL DISTRIBUTION
N41/N51 GEN/EXCT
R10 EPD
R11 MVD
R12 LVD
R13 VAC
R14 ICP
R15 LSP
R16 DC
R21 DG
AUXILIARY SYSTEMS
G62 TBS
G63 RBS
P51 SAIR
P52 IAIR
P54 N2
P61/P62 AUXB/ASS
W12 ISS
W13 ISNS
Y54 ES
HVAC & VENTILATION
P56 RAIR
T41 RBHV
T42 TBHV
T43 CBHV
T51 SGHV
T52 MHHV
T54 AFHV
T55 PBPV
T57 EBV
T58 CWPV
CONDENSATE & FEEDWATER
C31 FWC
G61 CPS
N21 COND
N22 FW
N37 MFTE
N38 MFLO
ECCS
E11 RIR
E22 HPCF
E51 RCIC
ENVIRONMENTAL
T61 ARM
T63 PRM
Y47 MET
RAD WASTE BUILDING
K11 SUMP
K15 FDRT
P31 NRD
T63 RTHV
PGCS
ENGR MENU
CLPS
PLANT ALARMS
CORE MONITR
CHANGE ENV
OPER AIDS
ENGR MENU
SPDS
REPORT
GROUP POINTS
PRINT
LTD
PAGE
PAGE


FoxView S91013:S91013 - 1C91GD001_001
Sat 11/23/2002 10:34:26
File Help
System
Process
SIM 1C91
Engineer Menu
Page 1 of 2
IA Utilities
System Monitor
Historian
Command
Graphic Editor
Report Generator
Control Configurator
Gateway Configurator
Shutdown
FoxSelect
Reboot
Preferences
ENGR MENU
OPER MENU
CHANGE ENV
PRINT
GROUP POINTS
LTD
PAGE
PAGE

II. 操作與顯示畫面則如下圖所示: (僅列舉兩個畫面代表):

它是利用 FoxView Screen Components、Mouse、Trackball、Alphanumeric Keyboard、Annunciator／Numeric Keyboard 的人機介面元件與一組事先定義好的 display 及程序控制圖去監督現場的程序或模擬。



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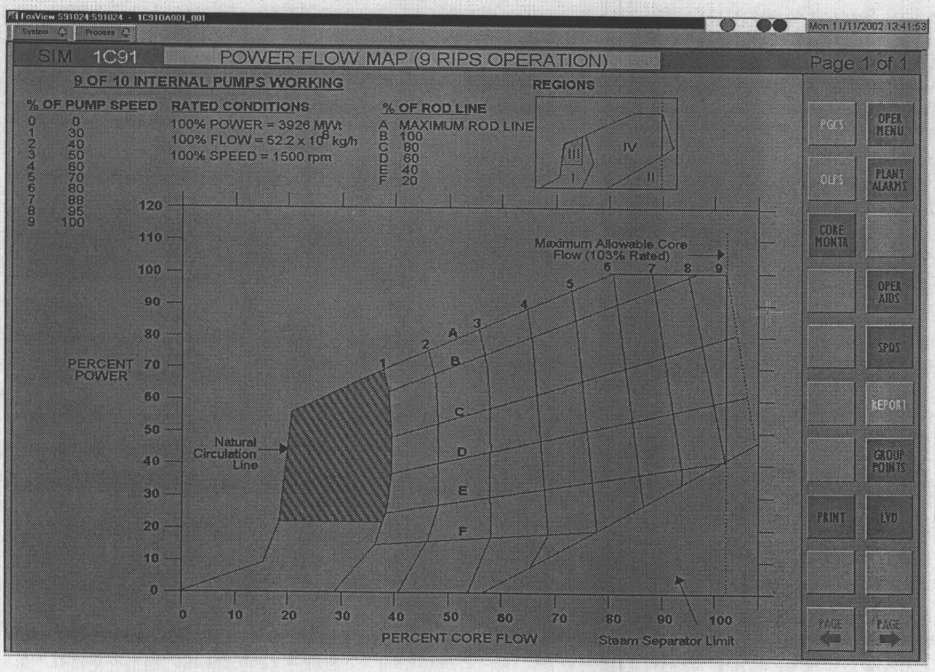


核四廠操作畫面至目前爲止的數量表:

TABLE 1. MAIN MENU DISPLAYS

MAIN MENU DISPLAYS
NONSAFETY
DIV 0
DIV 1
DIV 2
DIV 3
DIV 4

TABLE 2. SYSTEM DISPLAYS

	SYSTEM ID'S	GROUP NAME	NONSAFETY	DIV 0	DIV I	DIV II	DIV III	DIV IV	DCT REV
1	B21/N15 MS TBP	MAIN STEAM & REHEAT	10		1	1	1		REV 1
2	B22/N14 RS MSR	MAIN STEAM & REHEAT	10						REV 0
3	B31/C81 RCIR RFC	VESSEL & AUXILIARY	11						REV 1
4	C11 RCIS	Hitachi	30						
5	C11 RCIS	VESSEL & AUXILIARY	7						REV 1
6	C12 CRD	VESSEL & AUXILIARY	4						REV 1
7	C31 FWC	CONDENSATE & FEEDWATER	3						REV 1
8	C41 SLC	VESSEL & AUXILIARY	2		2	2			REV 0
9	C51 NMS	VESSEL & AUXILIARY	27		2	2	2	2	REV 0
10	C71 RPS	SAFETY & PROTECTION	2		1	1	1	1	REV 1
11	C73/C74 LDI/SSLC	SAFETY & PROTECTION	18		10	10	7	6	REV 1
12	C81		11						
13	C82 APR	PLANT AUTOMATION	15						REV 0
14	C85 SBPC	VESSEL & AUXILIARY	7						REV 1
15	C91	PLANT AUTOMATION	131						KAHLIM
16	E11 RHR	ECCS	9		3	3	3		REV 1
17	E22 HPCF	ECCS	6			4	4		REV 1
18	E51 RCIC	ECCS	4		4	1	1	1	REV 1
19	G31 RWCU	VESSEL & AUXILIARY	2						REV 1
20	G41 FPCU	WATER SYSTEMS	5						REV 1
21	G42 AFPC	WATER SYSTEMS	4						REV 0
22	G51 SPCU	WATER SYSTEMS	2						REV 1
23	G61 CPS	CONDENSATE & FEEDWATER	8						REV 0
24	G62 TBS	AUXILIARY SYSTEMS	3						REV 0
25	G63 RBS	AUXILIARY SYSTEMS	3						REV 0
26	H11		3						

	SYSTEM ID'S	GROUP NAME	NONSAFETY	DIV 0	DIV I	DIV II	DIV III	DIV IV	DCT REV
27	K11 SUMP	RAD WASTE BUILDING	19						REV 0
28	K15 FDRT	RAD WASTE BUILDING	2						REV 0
29	K68 OG	TURBINE & CONDENSER	8						REV 0
30	N11 HPED	EXTRACTION & HDS	2						REV 0
31	N12 LPED	EXTRACTION & HDS	2						REV 0
32	N14		10						
33	N21 COND	CONDENSATE & FEEDWATER	10						REV 1
34	N22 FW	CONDENSATE & FEEDWATER	18						REV 1
35	N23 FWD	TURBINE & CONDENSER	8						REV 0
36	N31 TURB	TURBINE & CONDENSER	5						REV 0
37	N32 EHC	TURBINE & CONDENSER	2						REV 1
38	N33 TGS	TURBINE & CONDENSER	5						REV 1
39	N34/N35 TLO/TLOS	TURBINE & CONDENSER	4						REV 0
40	N37 MFTE	CONDENSATE & FEEDWATER	4						REV 1
41	N38 MFLO	CONDENSATE & FEEDWATER	5						REV 1
42	N41/N51 GEN/EXCT	ELECTRICAL DISTRIBUTION	4						REV 1
43	N42 GGC	TURBINE & CONDENSER	1						REV 0
44	N43 GSC	TURBINE & CONDENSER	1						REV 0
45	N44 HSO	TURBINE & CONDENSER	1						REV 0
46	N61 CDSR	TURBINE & CONDENSER	7						REV 1
47	P11 MW	WATER SYSTEMS	6						REV 1
48	P13 CSTF	WATER SYSTEMS	2						REV 1
49	P16 FP	WATER SYSTEMS	1						REV 1
50	P21 RBCW	WATER SYSTEMS	11		2	2	2		REV 1
51	P22 TBCW	WATER SYSTEMS	4						REV 0
52	P24 NCW	WATER SYSTEMS	6						REV 1
53	P25 ECW	WATER SYSTEMS	6		1	1	1		REV 1
54	P26 RBSW	WATER SYSTEMS	6		1	1	1		REV 0
55	P27 TBSW	WATER SYSTEMS	3						REV 0
56	P28 CCW	TURBINE & CONDENSER	8						REV 0
57	P29 BPCW	WATER SYSTEMS	2						REV 0
58	P30 TBC	WATER SYSTEMS	6						REV 0
59	P31 NRD	RAD WASTE BUILDING	4						REV 0
60	P51 SAIR	AUXILIARY SYSTEMS	3						REV 0
61	P52 IAIR	AUXILIARY SYSTEMS	5						REV 1
62	P54 N2	AUXILIARY SYSTEMS	2		1	1			REV 1

	SYSTEM ID'S	GROUP NAME	NONSAFETY	DIV 0	DIV I	DIV II	DIV III	DIV IV	DCT REV
63	P56 BAIR	HVAC & VENTILATION	1						REV 0
64	P61/P62 AUXB/ASS	AUXILIARY SYSTEMS	4						REV 0
65	R10 EPD	ELECTRICAL DISTRIBUTION	12	1	1	1	1		REV 1
66	R11 MVD	ELECTRICAL DISTRIBUTION	14	1	4	1	1		REV 1
67	R12 LVD	ELECTRICAL DISTRIBUTION	17	1	1	1	1		REV 1
68	R13 VAC	ELECTRICAL DISTRIBUTION	14	1	1	1	1	1	REV 1
69	R14 ICP	ELECTRICAL DISTRIBUTION	2						REV 0
70	R15 LSP	ELECTRICAL DISTRIBUTION	1						REV 0
71	R16 DC	ELECTRICAL DISTRIBUTION	18	1	1	1	1	1	REV 1
72	R21 DG	ELECTRICAL DISTRIBUTION	29	6	5	5	5		REV 1
73	T22 SGT	CONTAINMENT	2			1	1		REV 1
74	T31 ACS	CONTAINMENT	2		1	1	1		REV 1
75	T40 DWC	CONTAINMENT	3						REV 1
76	T41 RBHV	HVAC & VENTILATION	30		4	4	4		REV 1
77	T42 TBHV	HVAC & VENTILATION	7						REV 0
78	T43 CBHV	HVAC & VENTILATION	17		1	3	3		REV 1
79	T49 FCS	CONTAINMENT	3			2	1		REV 0
80	T51 SGHV	HVAC & VENTILATION	4						REV 0
81	T52 HMHV	HVAC & VENTILATION	3						REV 1
82	T53 RTHV	RAD WASTE BUILDING	2						REV 0
83	T54 AFHV	HVAC & VENTILATION	7	1	1				REV 1
84	T55 RBPV	HVAC & VENTILATION	8		1	1	1		REV 0
85	T57 EBV	HVAC & VENTILATION	1						REV 0
86	T58 CWPV	HVAC & VENTILATION	1						REV 1
87	T61 ARM	ENVIRONMENTAL	19						REV 1
88	T62 CMS	CONTAINMENT	20		7	7	3	3	REV 1
89	T63 PRM	ENVIRONMENTAL	4		1	1	1	1	REV 1
90	W12 ISS	AUXILIARY SYSTEMS	9		1	1	1		REV 0
91	W13 ISNS	AUXILIARY SYSTEMS	5						REV 0
92	Y47 MET	ENVIRONMENTAL	X						NONE
93	Y54 ES	AUXILIARY SYSTEMS	3						REV 0
			792	12	58	60	49	16	987

從 STN 到控制盤顯示 PCS 相關點之對應表:

PointID	AOS Variables	Intermediate Block	PCS Block	Station Name (Destination)
0P16P5001B52A	0P16S:P5001B52A.CIN	0P16:P5001B52A.CIN	1C91_3334:DP16S0030_L1	591026
0T64RT5001	0T64S:RT5001.PNT	0T64:RT5001.PNT	1C91_221:AT63C0010_S2	591025
0T64RT5002	0T64S:RT5002.PNT	0T64:RT5002.PNT	1C91_221:AT63C0010_S2	591025
0T64RT5003	0T64S:RT5003.PNT	0T64:RT5003.PNT	1C91_221:AT63C0010_S2	591025
0T64RT5004	0T64S:RT5004.PNT	0T64:RT5004.PNT	1C91_221:AT63C0010_S2	591025
0T64RT5005	0T64S:RT5005.PNT	0T64:RT5005.PNT	1C91_221:AT63C0010_S2	591025
0T64RT5006	0T64S:RT5006.PNT	0T64:RT5006.PNT	1C91_221:AT63C0010_S2	591026
0T64RT5007	0T64S:RT5007.PNT	0T64:RT5007.PNT	1C91_221:AT63C0010_S2	591025
0T64RT5008	0T64S:RT5008.PNT	0T64:RT5008.PNT	1C91_221:AT63C0010_S2	591026
0T64RT5009	0T64S:RT5009.PNT	0T64:RT5009.PNT	1C91_221:AT63C0010_S1	591025
0T64RT5010	0T64S:RT5010.PNT	0T64:RT5010.PNT	1C91_221:AT63C0010_S1	591026
0Y471001A048L	LA0Y47S:1001A048L.PNT	LA0Y47:1001A048L.PNT	1A51_CTPCALC:30_3_L1	591030
1B211001D001X	XA1B21S:1001D001X.CIN	XA1B21:1001D001X.CIN	1C91_3222:AC73V2001_L1	591027
1B211001D002X	XA1B21S:1001D002X.CIN	XA1B21:1001D002X.CIN	1C91_3222:AC73V3001_L1	591027
1B211001D003X	XA1B21S:1001D003X.CIN	XA1B21:1001D003X.CIN	1C91_3222:AC73V2002_L1	591027
1B211001D004X	XA1B21S:1001D004X.CIN	XA1B21:1001D004X.CIN	1C91_3222:AC73V3002_L1	591027
1B211001D005X	XA1B21S:1001D005X.CIN	XA1B21:1001D005X.CIN	1C91_3222:AC73V2003_L1	591027
1B211001D006	1B21S:1001D006.CIN	1B21:1001D006.CIN	1C91_3222:AC73V3003_L1	591027
1B211001D006X	XA1B21S:1001D006X.CIN	XA1B21:1001D006X.CIN	1C91_3222:AC73V3003_L1	591027
1B211001D007X	XA1B21S:1001D007X.CIN	XA1B21:1001D007X.CIN	1C91_3222:AC73V2004_L1	591027
1B211001D008X	XA1B21S:1001D008X.CIN	XA1B21:1001D008X.CIN	1C91_3222:AC73V3004_L1	591027
1B211001D009	1B21S:1001D009.CIN	1B21:1001D009.CIN	1C91_3222:AC73V0001_L1	591027
1B211001D009	1B21S:1001D009.CIN	1B21:1001D009.CIN	1C91_3222:AC73V2001_L1	591027
1B211001D010	1B21S:1001D010.CIN	1B21:1001D010.CIN	1C91_3222:AC73V0002_L1	591027
1B211001D010	1B21S:1001D010.CIN	1B21:1001D010.CIN	1C91_3222:AC73V2002_L1	591027
1B211001D011	1B21S:1001D011.CIN	1B21:1001D011.CIN	1C91_3222:AC73V0003_L1	591027
1B211001D011	1B21S:1001D011.CIN	1B21:1001D011.CIN	1C91_3222:AC73V2003_L1	591027
1B211001D012	1B21S:1001D012.CIN	1B21:1001D012.CIN	1C91_3222:AC73V0004_L1	591027
1B211001D012	1B21S:1001D012.CIN	1B21:1001D012.CIN	1C91_3222:AC73V2004_L1	591027
1B211001D013	1B21S:1001D013.CIN	1B21:1001D013.CIN	1C91_3222:AC73V3001_L1	591027
1B211001D013	1B21S:1001D013.CIN	1B21:1001D013.CIN	1C91_3222:AC73V3001_L1	591027
1B211001D013X	XA1B21S:1001D013X.CIN	XA1B21:1001D013X.CIN	1C91_AA6_DP:AD6	591031
1B211001D014	1B21S:1001D014.CIN	1B21:1001D014.CIN	1C91_3222:AC73V0002_L1	591027
1B211001D014	1B21S:1001D014.CIN	1B21:1001D014.CIN	1C91_3222:AC73V3002_L1	591027
1B211001D015	1B21S:1001D015.CIN	1B21:1001D015.CIN	1C91_3222:AC73V0003_L1	591027
1B211001D016	1B21S:1001D016.CIN	1B21:1001D016.CIN	1C91_3222:AC73V3004_L1	591027
1B211001D016	1B21S:1001D016.CIN	1B21:1001D016.CIN	1C91_3222:AC73V3004_L1	591027
1B211002A030X	XA1B21S:1002A030X.PNT	XA1B21:1002A030X.PNT	1A51_CTPCALC:30_4_L1	591030
1B211002A030X	XA1B21S:1002A030X.PNT	XA1B21:1002A030X.PNT	1C91_1B21_DP:1002A030X_L1	591026

III. 模擬器輸出 / 入介面：

核四廠模擬器採用 Distributed RTP System 做主電腦(LMCC1)與操作開關(Switch Module)之間的輸出 / 入介面，其架構如下圖所示。

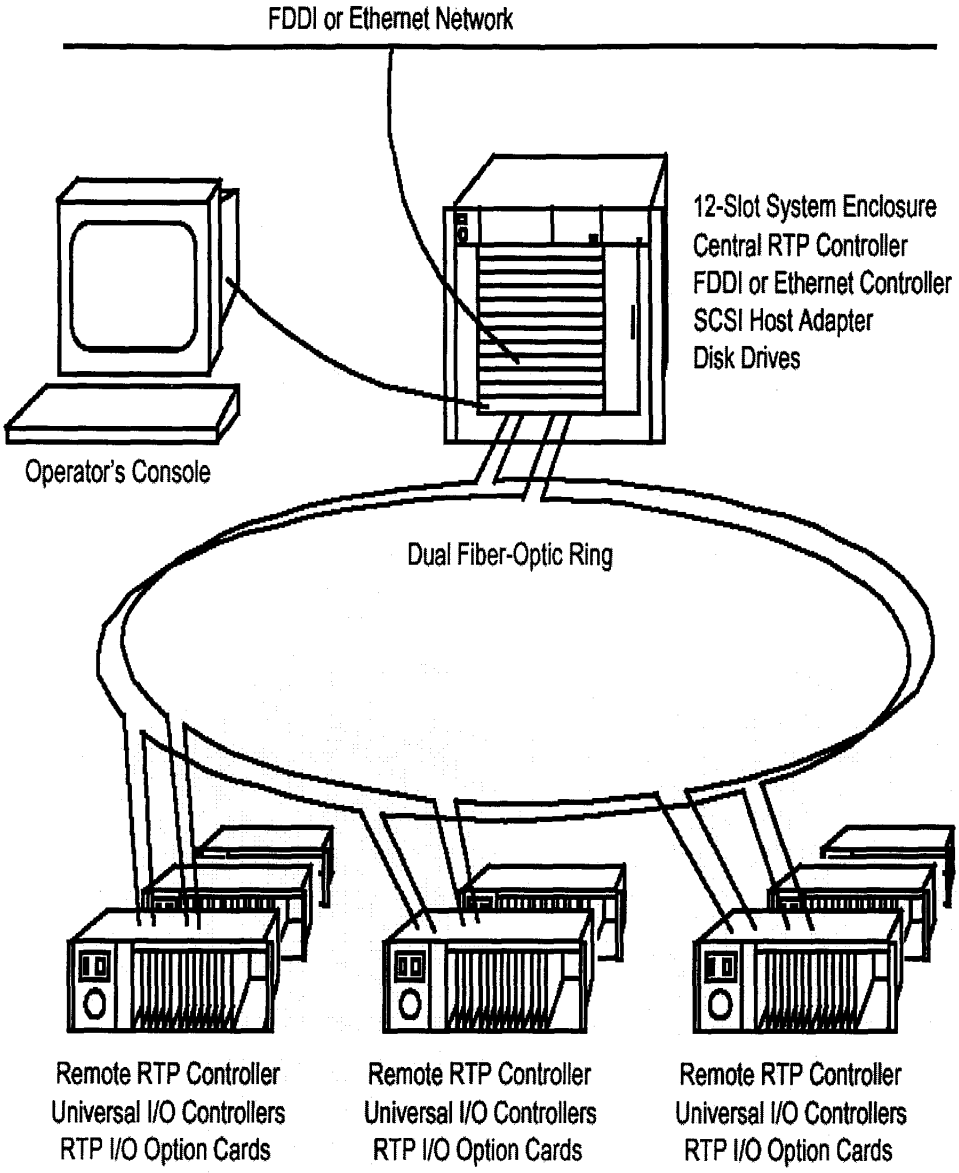


Figure 1-1. Typical Distributed RTP System

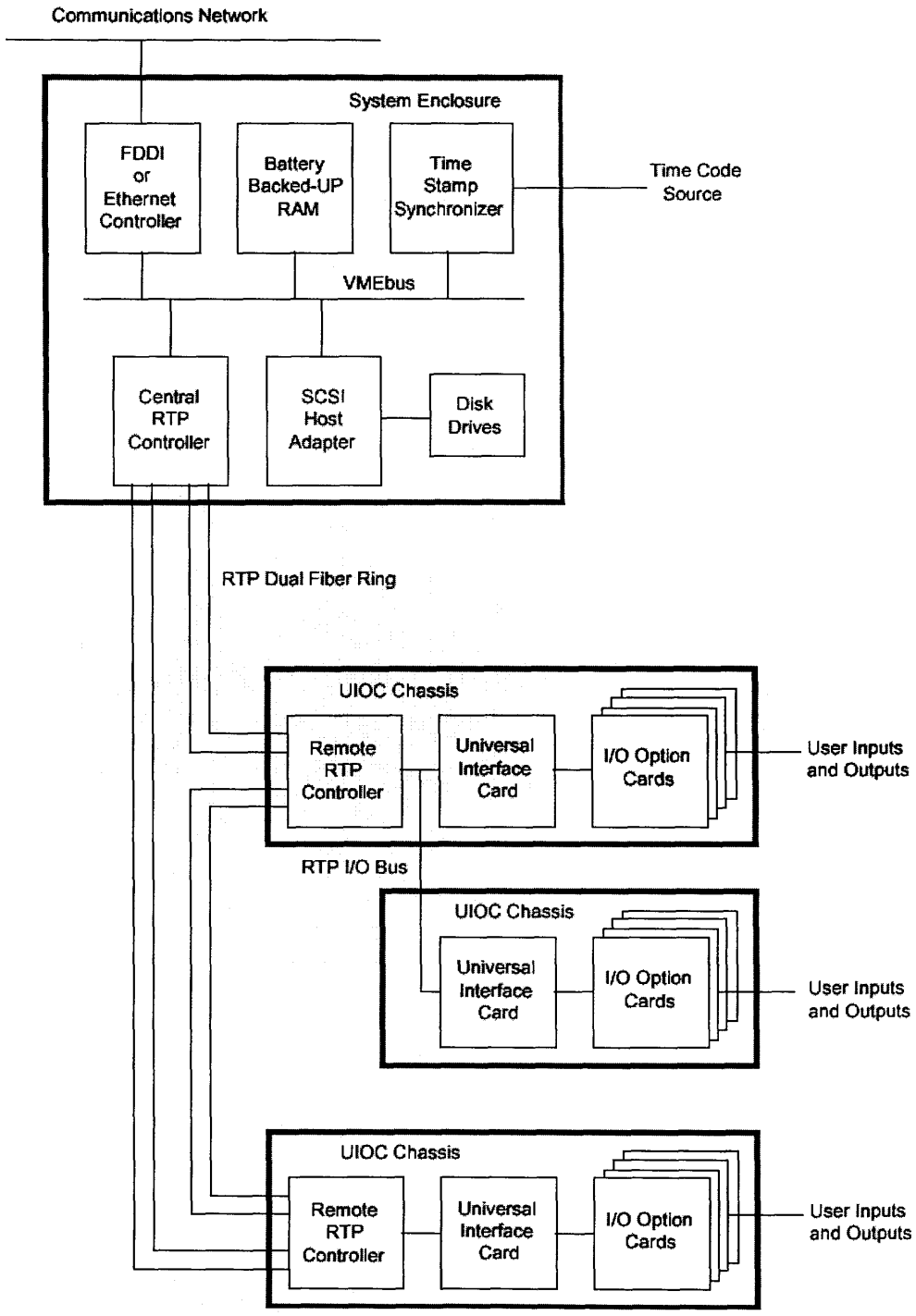


Figure 3-4. Distributed RTP System Block Diagram

一、系統描述：

DRTP 是一個資料庫控制輸出/輸入系統，其有自我掃描、工程單位轉換、計算、環路控制、先後事故時間標示等能力，它經由一片 FDDI(Fiber Distributed Data Interface)介面與主電腦(host computer)做網路連接，本系統含有下列設備:

1. Central controller
2. V4211FDDI Node Processor
3. Remote controller (P/N：RTP6620/10)
4. Universal board (P/N：021-5419-000)
5. Terminator board (P/N：021-0004-000)
6. 16 Bits Digital I/O board(P/N：7438/20-052 021-5241-052)
7. 8 Bits Analog I/O board (P/N：7438/50-000 021-5244-000)

Central controller 爲含有 HK68/V4F processor 之 computer，其附有一片 fiber-optic serial data link controller (FDB)，FDB 插在 VME Chassis 的第一個 slot 內且做爲系統的控制器，FDB 提供 HK68/V4F processor 與 RTP fiber optic rings 之間的界面，FDB 可依串列方式連八個 Remote Controller。

FDB 是一個以 68030 爲基礎的通訊控制器且含有兩個獨立的光纖通訊通道，在 DRTP 系統 FDB 扮演主要的串列資料連結控制器(Serial Data Link Controller SDLC)通訊站，Remote RTP Controller 受 FDB 的控制來回應通訊，兩個通訊每秒的傳輸率爲 20MB，因 FDB 能用任一條連線故如有一條連線斷掉，DRTP 系統仍能繼續運做。

DRTP 系統之軟體儲存在 HK68/V4F 電路板的 ROM 裡面，當啓動 DRTP 時 HK68/V4F 會 Download 控制此系統結構和操作之 run-time object code 至 FDB。

DRTP 包含一個 PROM 常駐 database compiler， 此 database 由 host computer download，後在 DRTP 系統 compile，Database 以 ASCII 方式存在主電腦裏,可用此電腦來修改 database。

除了由 database 產生 runtime data structures 外， compiler 則產生 runtime executable code 以執行 DRTP 系統之輸出 / 輸入計算功能，並建立控制執行表格碼，因此依據 database 的大部分計算是由 compile time 來判斷而非 runtime，結果能造成快速的執行。

由 compile 產生之輸出再 up-loaded 至 host computer， Binary database 將被儲存稍後在 downloaded 至 DRTP 系統和執行。

DRTP 有兩組 database 結構的能力,如此它能用任意一組 database 做系統掃瞄 ，同時用另一組 database 做 download、 compile、upload。

Compiler 產生一個包含記錄名單對應記錄號碼的報告，這些記錄號碼將由主電腦在經由 Ethernet interface、 FDDI、 或 VME bus 讀/寫信號點資料時使用。此 Compiler 執行大量的資料庫並檢查錯誤，且將此錯誤做出報告。

Central RTP 控制器、通信控制器、Remote RTP 控制器、當電源啓動時，每個都有自我測試能力，這些卡片均有 LED 指示燈，如自我測試失敗時由指示燈便可了解故障卡片。

DRTP 系統軟體使用 RTP interrupts 信號給 A/D converter cards、 pulse counter cards、 frequency counter cards、 change of state interrupt cards、 programmable delay counter cards，RTP 硬體架構必須提供連續的 interrupt acknowledge signal 信號給上述卡片，任何在 RTP controller 和上述卡片之間如無插入卡片則必須插入 interrupt pass through cards 否則在背盤的 interrupt acknowledge signal 必須短路。

V 4211 FDDI 是一個 RISC-based high-performance node processor，其提供每秒 100Mbit 光纖介面網路，此卡片包含一個 AMD SUPERNET 晶片以設定 FDDI 介面，一個 16Mhz29000RISC 處理器，一個 1MB 通訊緩衝器，一個 high-performance VMEbus 介面。

Remote RTP Controller 是一個以 68030-based I/O 控制器，他含自己的處理器、ROM、RAM 和計時器、一個通訊控制器跟兩個獨立光纖通訊通道、一個 RTP I/O Bus Converter。 在送電後 Remote RTP Controller 將由 RTP 光纖環路啓動，後 Central RTP Controller 將 Down-loads run-time object code 至本系統所有之 Remote RTP Controllers。則 Central RTP Controller 將負責收集掃描之資料格式，且傳送輸出資料至 RTP I/O Option cards ，Central Controller 也對類比輸入資料執行信號條件功能，和在 SOE 輸入和暫態記錄資料輸入貼上時間標籤。

RTP I/O Bus Converter 則經由標準 RTP I/O Bus 提供至 Universal I/O Controllers 的介面，它產生所有的時序和控制信號做 I/O Option Cards 的通訊，Remote RTP Controller 的 I/O Bus 可連八個 Universal I/O Controllers。

Universal I/O Controller 系統用來測量監視和控制類比/數位的處理它包含有下列設備

1. I/O Bus Converter(IOBC)，它提供主電腦與控制器之監得連線，並轉換主電腦的指令給 RTP I/O Bus。
2. RTP I/O Bus 它是有 32 條串並連的 Bus，它提供茲料得傳送控制和設備得位址及下列功能：
   RTP Command
   RTP Input
   RTP Output
   RTP Test
   Interrupt Query
3. Universal Interface Card(UI)它含有設備選擇控制(reset data direction card select)和 interrupt circuitry。

本系統亦包含下列輸出入卡片：

1. Digital Input/Output Card 一個 16-bit digital word 每個 bit 對應每個輸入信號狀態，

在輸入主電腦時便引發一個 16-bit digital word 輸出至使用者的電路。

2. Analog input/output Card AIO Card 依據由 chassis logic 所接收得控制信號傳送資料至使用者的連接器，此八個通道的類比輸入資料，或八個通道的類比輸出資料可分別傳送。

本系統採用雙光纖環路設備，每個 Node 含有兩個獨力的通信通道，輸入至通道 1 的是 RXA 連接器，輸入至通道 2 的是 RXB 連接器，在環路的模式下，輸入多工器能夠互換其通道位置，選擇其輸出通道當做輸入通道，在 TXA 的輸出可當通道 1 或通道 2 的輸出，在 TXB 的輸出亦可做爲通道 1 或通道 2 的輸出。

圖 3-5 描述 RTP 光纖環路在正常情況下的運做，Central RTP Controller 當做 Primary Station，每個 Remote RTP Controller 當做 Secondary Station，在 Central RTP Controller 通道 1 產生 transmits clock signal 和 transmits data 至 link A 和 link B。

Remote RTP Controllers 在通道 1 之 link A 接收 data，在 link A 使用 recovered clock signal 則傳送 data。同樣在在通道 2 之 link B 接收 data，在 link B 使用 recovered clock signal 則傳送 data。

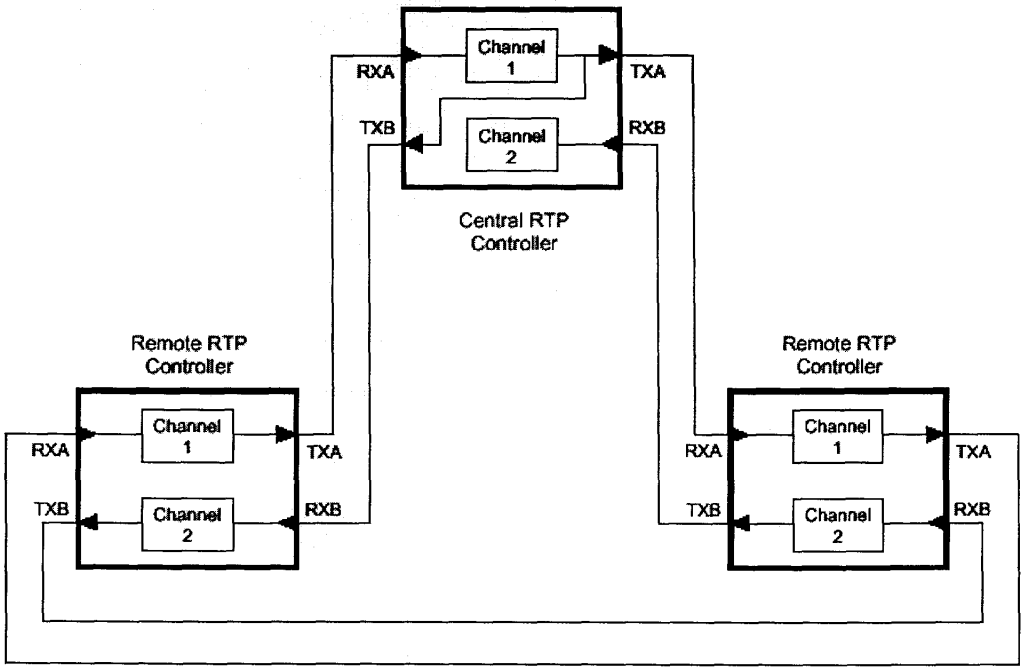


Figure 3-5. Normal RTP Fiber Ring Operation

下列爲光纖工作正常與非正常電路交換情形:

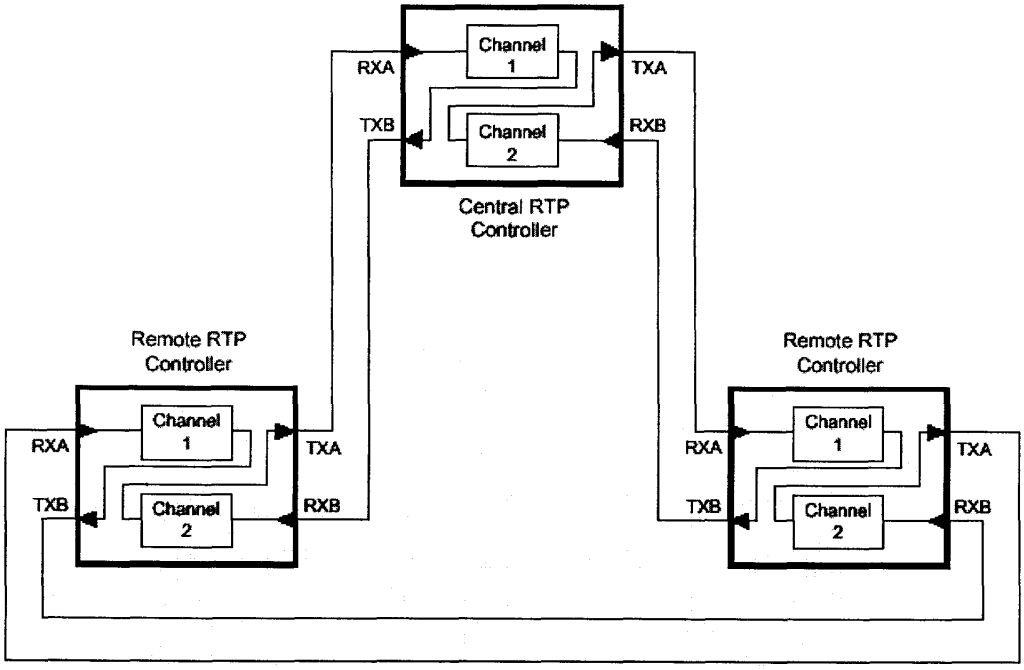


Figure 3-6. Alternate Loop RTP Fiber Ring Operation

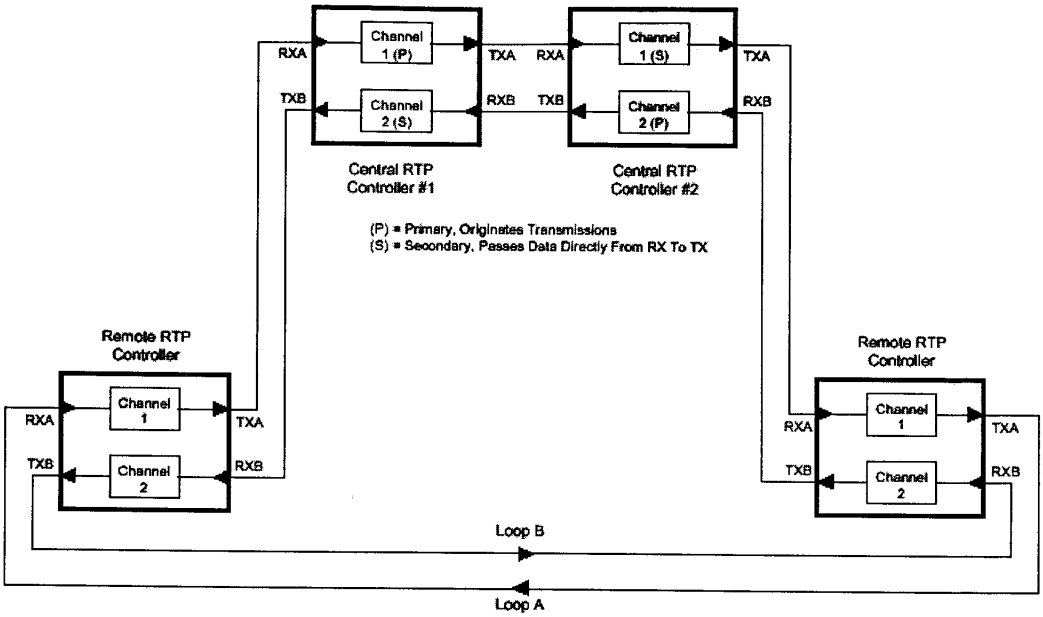


Figure 3-8. Normal Redundant System Operation

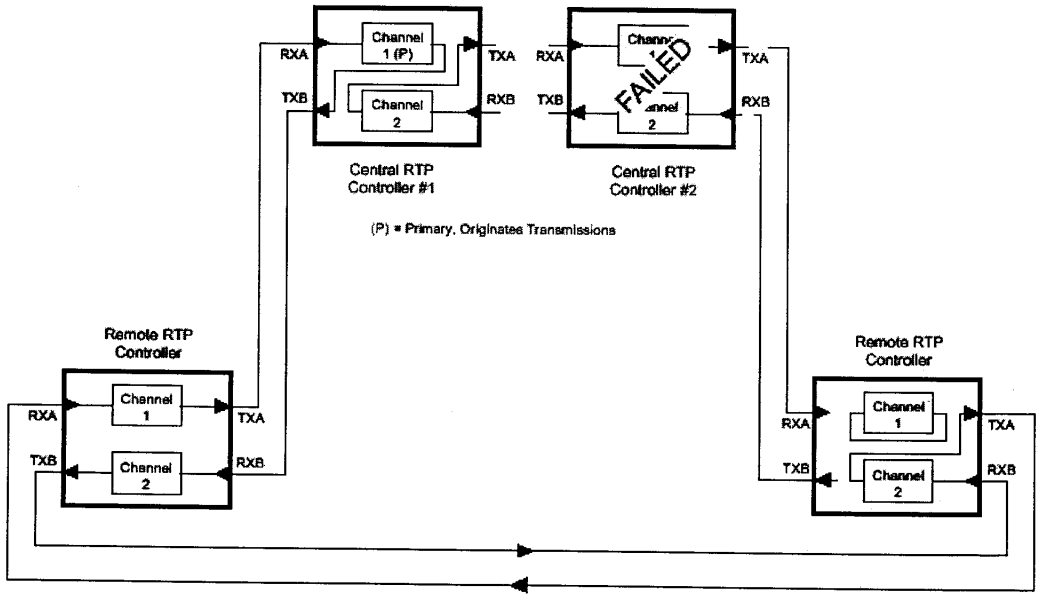


Figure 3-9. Redundant System, Central RTP Controller Failure

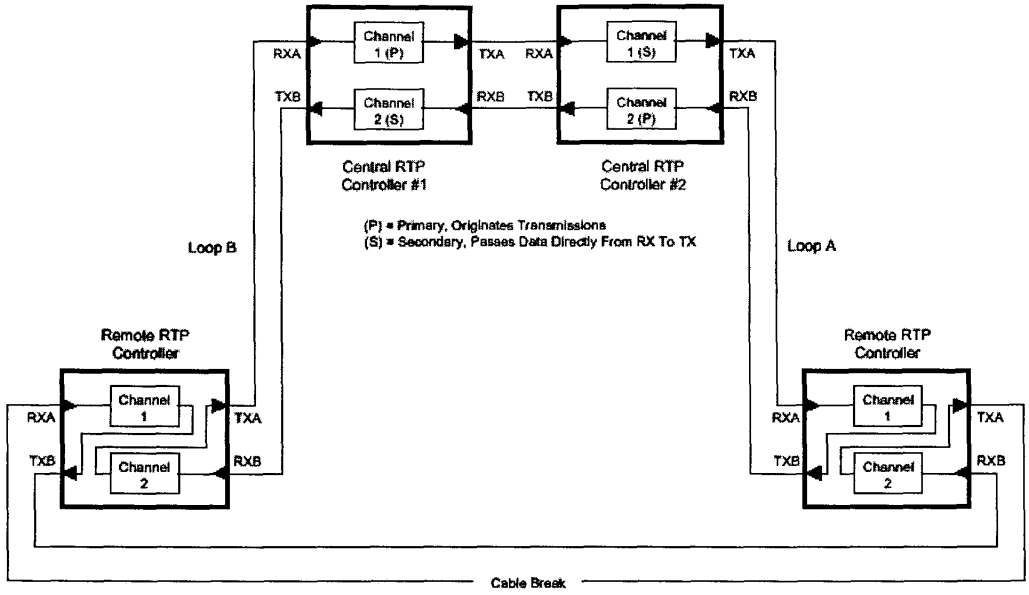
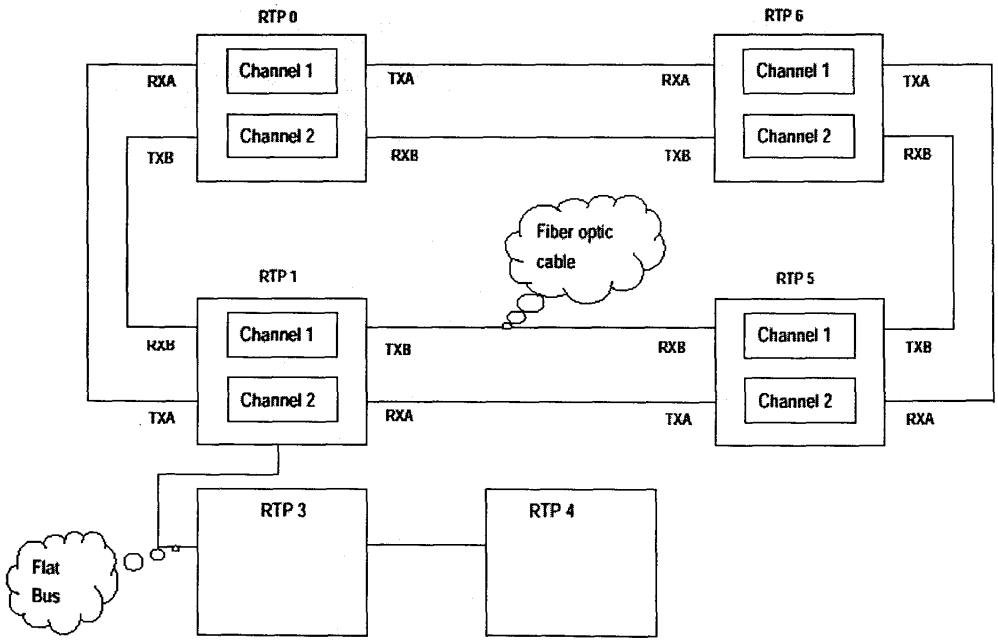


Figure 3-10. Redundant System, Remote Link Failure

核四廠 RTP 實際環路接線情形



Central RTP Controller and FDDI Node Processor 信號接線與指示燈圖示

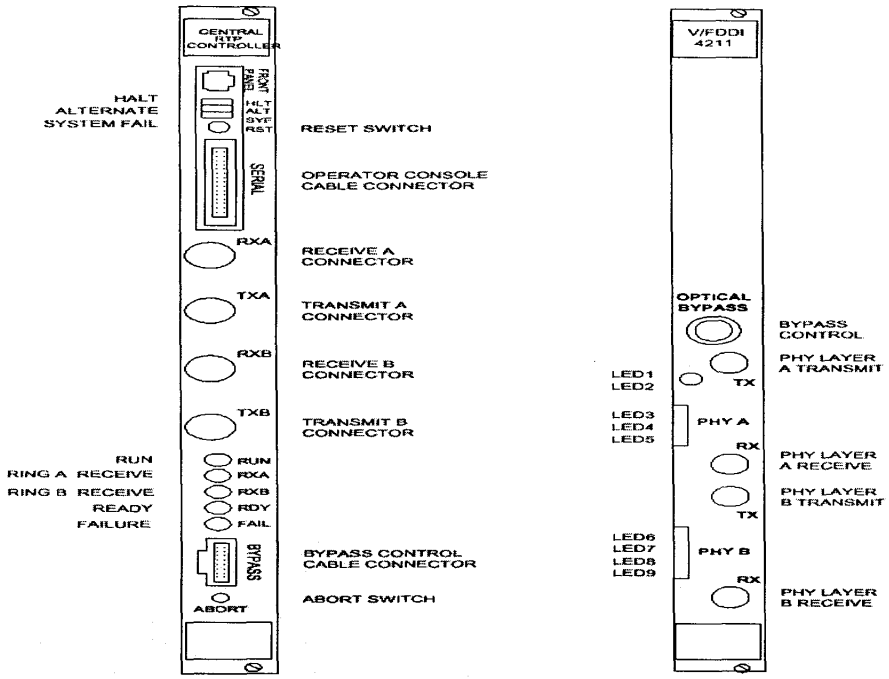


Figure 3-1. Central RTP Controller and FDDI Node Processor

IV. 核四廠 Mimic 設備介紹

一、系統概述

Mimic 設備，ALS 顯示控制系統，是由加拿大 SACO SmartVision Inc.所提供，它被用來做爲 Host Compute 和 Mimic Display Panel 之間的介面。

此系統包含一個電子電路板組件用以控制和驅動 LED，燈泡，和數字顯示器，每一顯示點和數位值 ALS 系統會保留原狀態，直到手控開關或監督電腦的改變才有變化。

本系統是爲模組化，可以依據輸入輸出之多寡要求做結構的改變，其組合了所有必須的驅動器、記憶體，控制和通訊邏輯。本系統之元件如下:

1. ALS-C　　Controller (1)
2. ALS-CX　　Expansion Board (1)
3. ALS-OS　　Output Board (low current) (38)
4. ALS-BCD　　BCD Driver Board (8)

5. BCD-DIST BCD Distribution Board (18)

本系統基本上可控制 2048 個訊號，如加上 ALS-CX Board 則可控制至 16384 個訊號，ALS-C 控制器可二個並連，避免如控制器故障時能正常運作。

二、元件描述

1 ALS-C Controller

ALS-C 控制器基本上是微處理器電路設計，用來更新顯示電腦點和數值的狀態，對每一個顯示點，它含有 512KRAM 記憶資料，因有後備電池，故在失電時並不會消失資料。

此控制器接收由 Host computer 來的指令，以改變電腦點的狀態或數位錶的值，每個點可設成下列狀態：

A. OFF
B. ON
C. SLOW FLASH
D. FAST FLASH
E. MODULATING
F. DIM

ALS-C 有一個自動燈泡測試指令，允許對控制盤面之所有數位錶、燈泡、LED 做 ON/OFF 檢測而不影響控制盤的狀況。

ALS-C 有一個 3-position key switch：

A.	Reset	reset / halt state
B.	Run	Control of display points via supervisory computer
C.	Manual	test

ALS-C 使用+5Vdc 電源，其有一只 LED 燈亮用以指示電源供應，另一只 LED 則用以監視保險絲，如保險絲斷掉則燈亮。

2 ALS-CX Expansion Board

此延伸電路板用以提供控制至 16384 個電腦點它用 flat ribbon cable 與 ALS-C Controller 做通訊連線。

ALS-CX 有八個輸出連接器，每個連接器用 flat ribbon cable 可接 32 個 ALS-OS Boards，如此可做 16384 個信號的存取(8x32x64)。

ALS-CX 提供一個硬體燈炮測試電路，即將 j12 連接器的 pins TST 和 GND 短路，如此可讓操作員了解燈炮是否故障。

3 ALS-OS Output boards

它是一個低電流(150mA)驅動電路板，其有 1 個連接器分成兩路，一端接 ALS-CX 另一端再接 ALS-OS,如此可並接 32 個 ALS-OS Boards。

每一個 Output board 有 64 個 transistor (or FET)做驅動輸出，故共可控制 2048(32x64)點，每個 board 均有一個 8-position DIP switch 用以設定在通信匯流排的位址。

Display lamps or LEDs 經由二條導線接至 64 個端子，一條接到 lamp 電源，另一

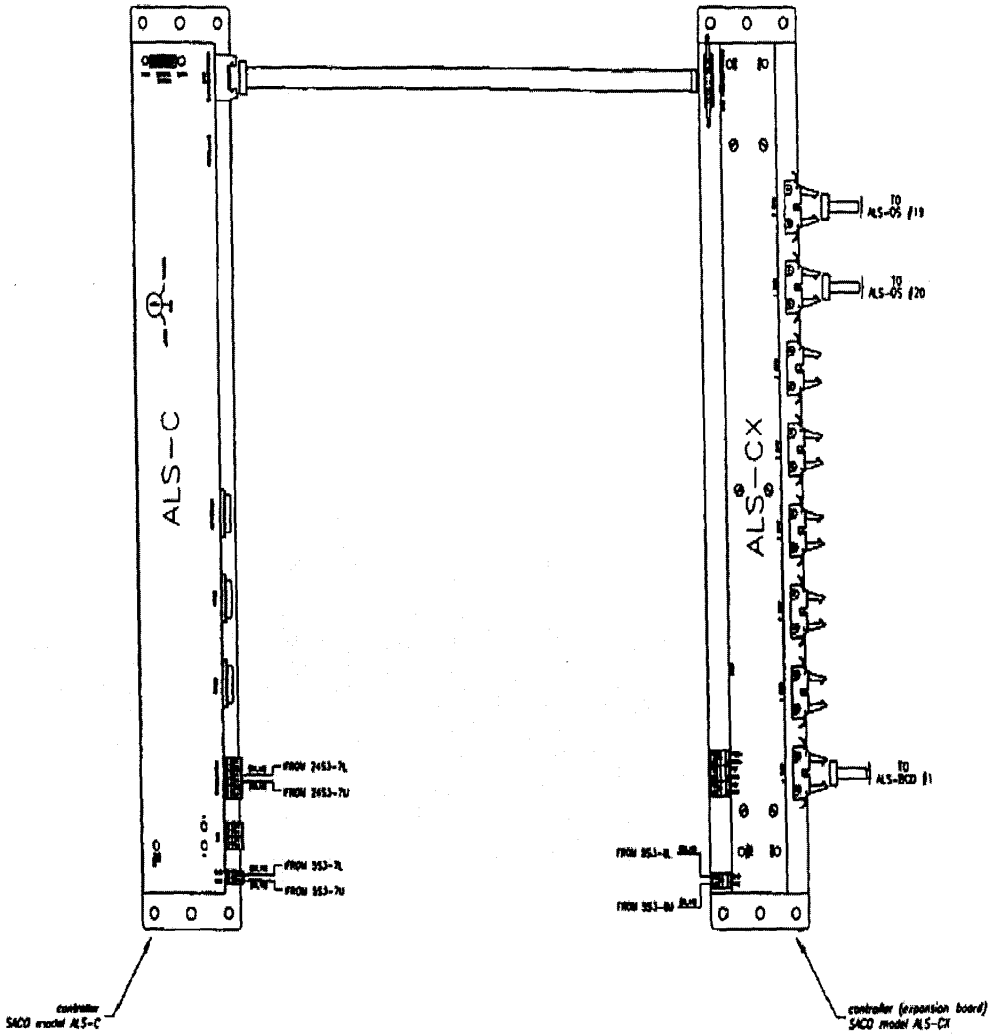
條經由 transistor (or FET)接到 lamp power return 端，本 Output boards 須 5Vdc 電源供給 logic circuitry 和 lamp voltage。

各個電腦點可有下列狀態： OFF、ON、 SLOW FLASH、 FAST FLASH 、MODULATING、 DIM。
每個輸出點都有一個 LED 做監視輸出狀態和 Trouble-shooting 目的。

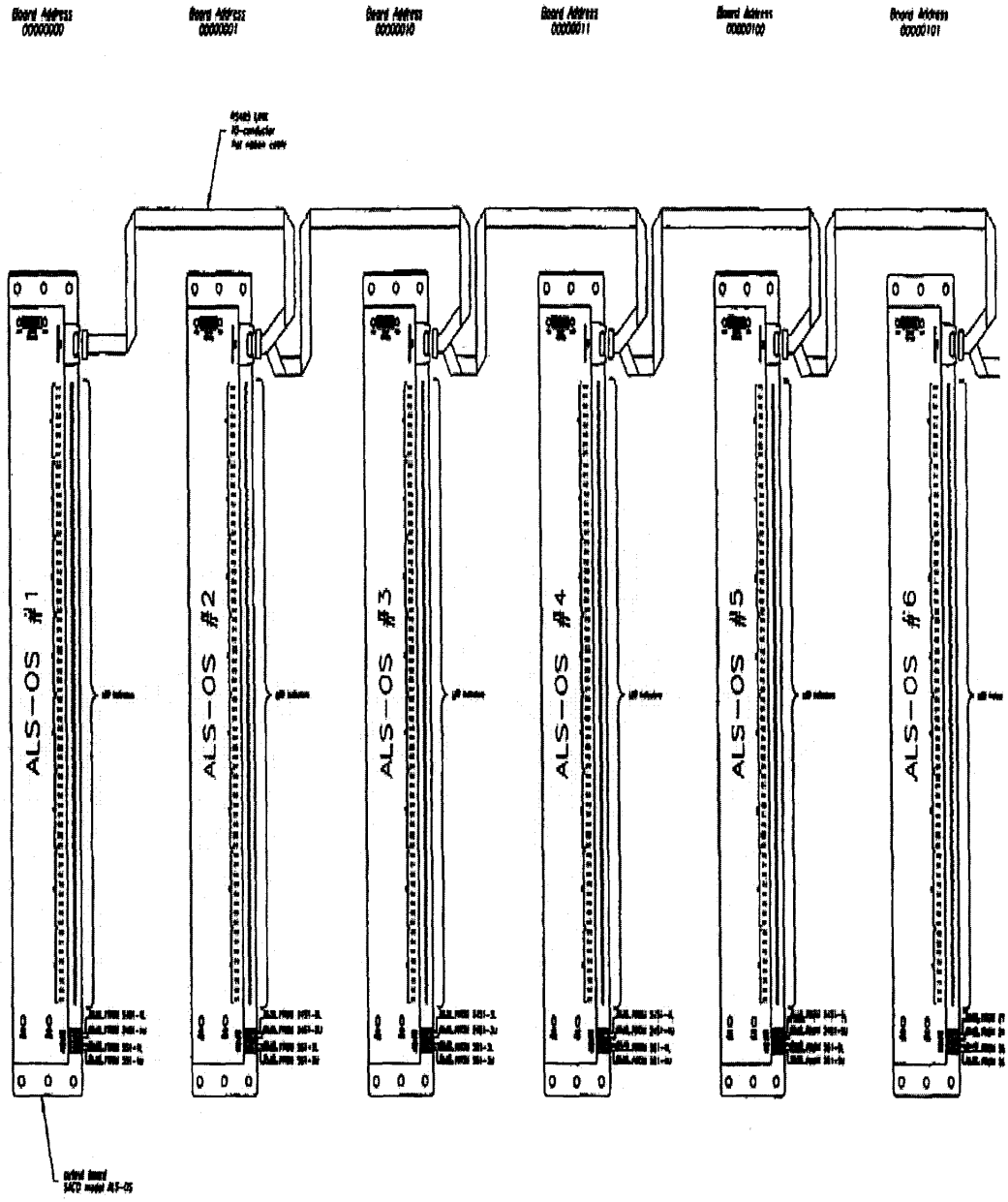
4 ALS-BCD Driver board
ALS-BCD 爲 ALS-C Controller 與 Digital display 之間的介面，ALS-BCD 可串接至 16 個，每個又可並接 4 個 DIST-BCD Distribution boards。

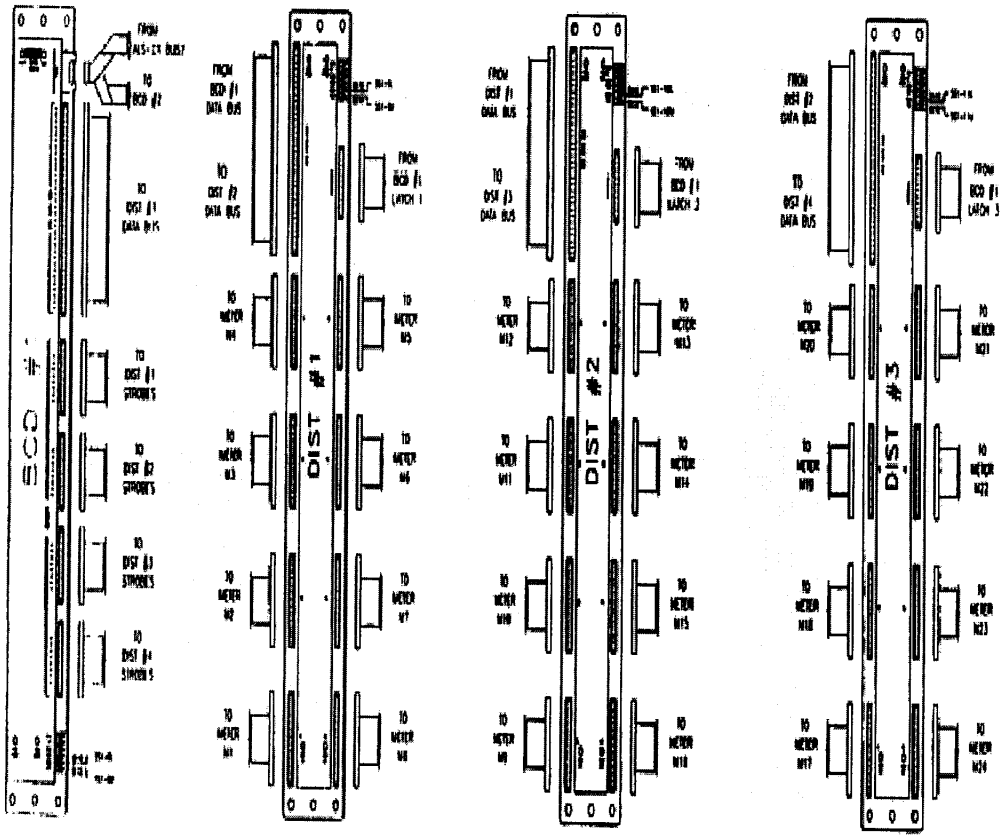
ALS-BCD 有一個 64 Pin data bus， 4 個 Latch Strobes。

5 BCD-DIST Distribution Board
BCD-DIST 有一個 data bus，一個 BCD Latch， 8 個 meter 連接器。


ALS-C
ALS-CX
controller
SACO model ALS-C
controller (expansion board)
SACO model ALS-CX

SECTION 3


ALS-OS #1
ALS-OS #2
ALS-OS #3
ALS-OS #4
ALS-OS #5
ALS-OS #6



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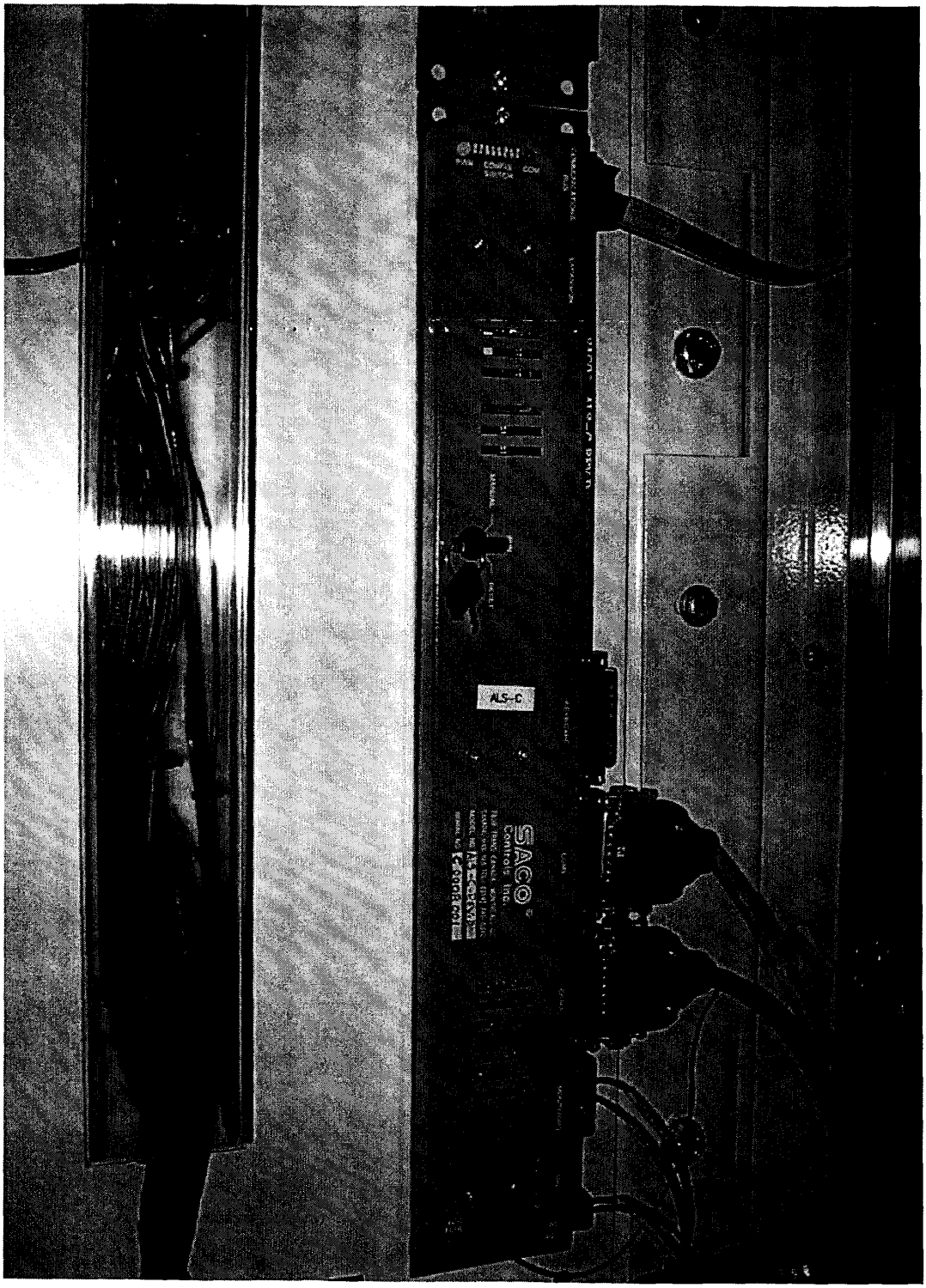
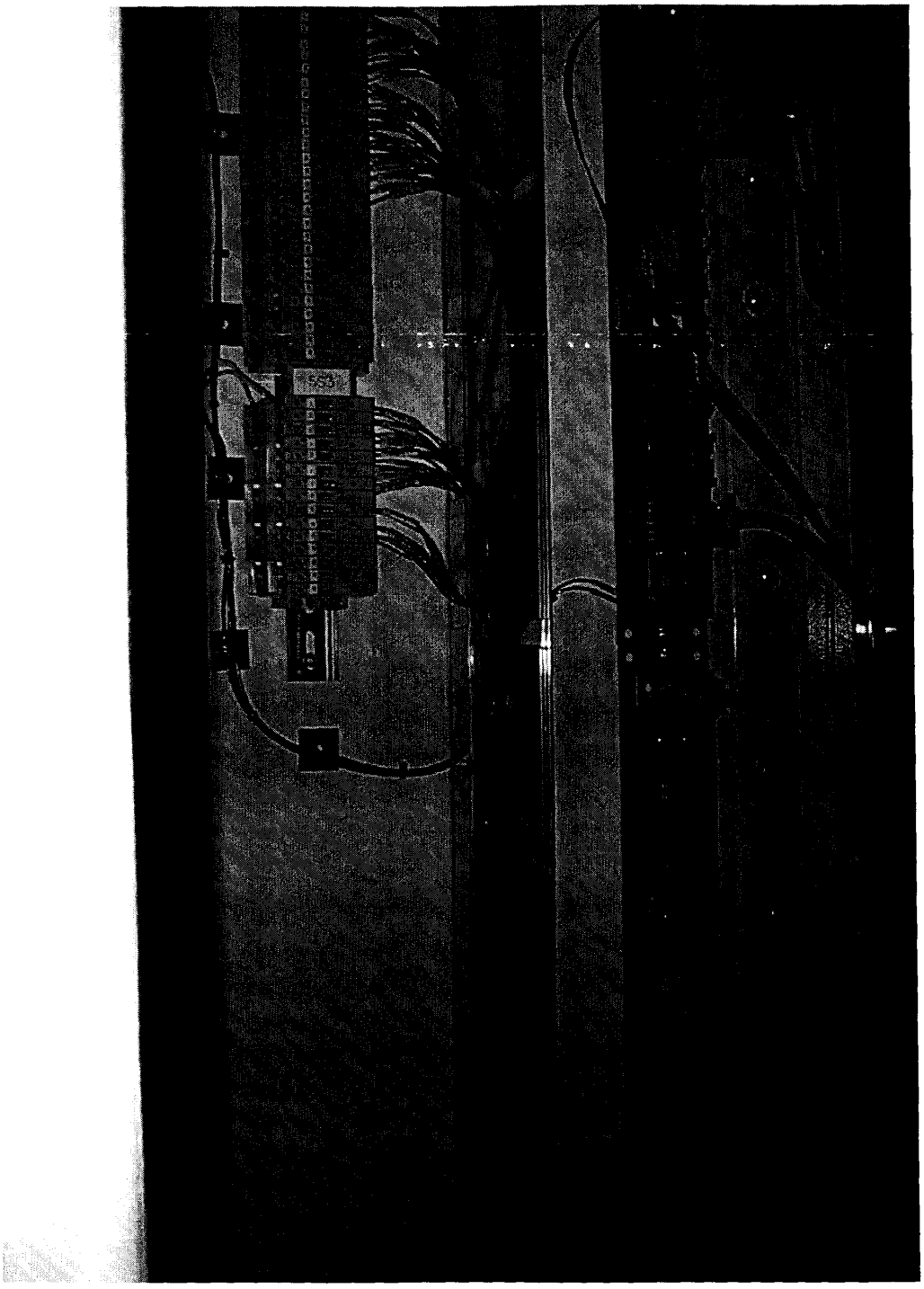
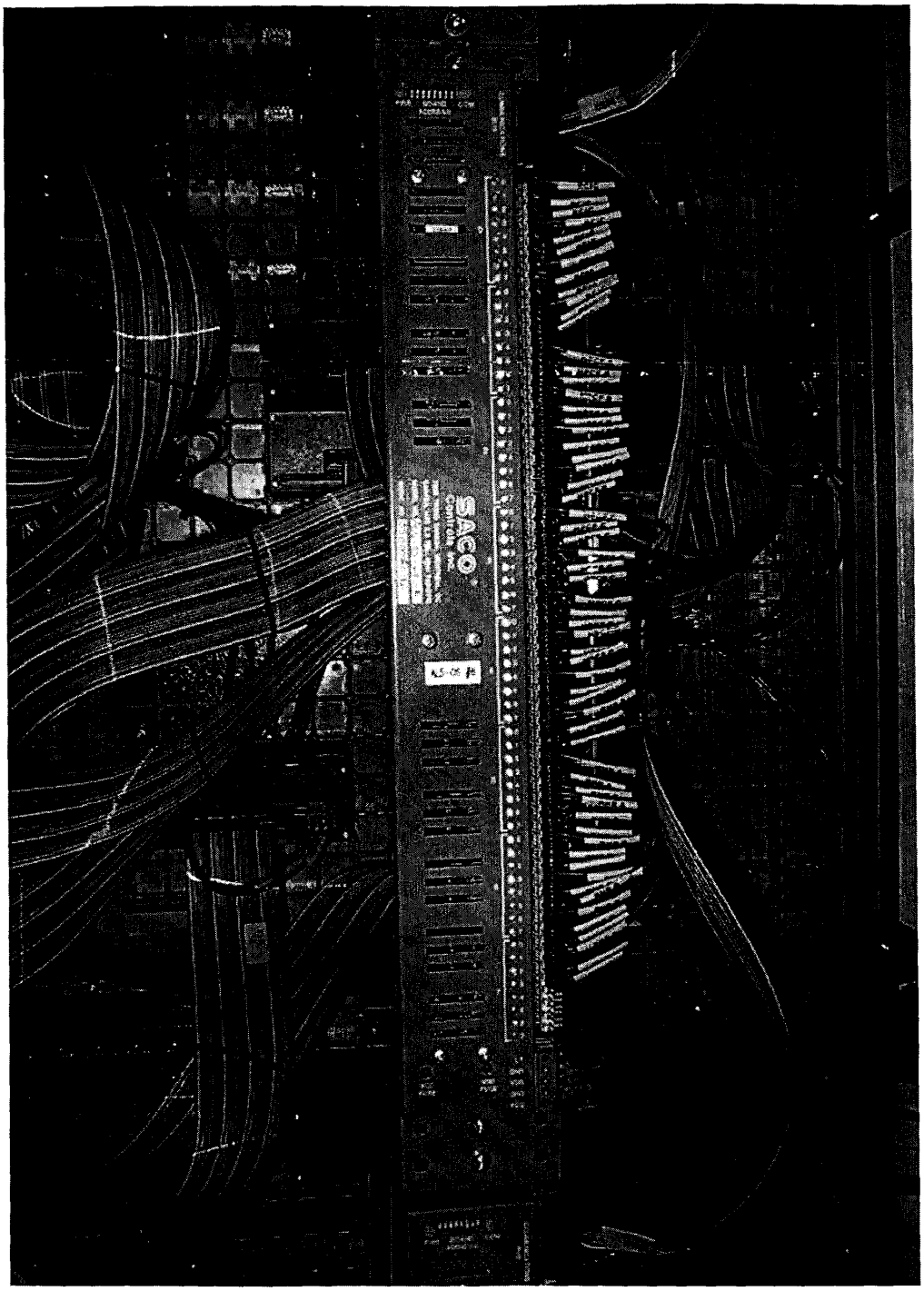
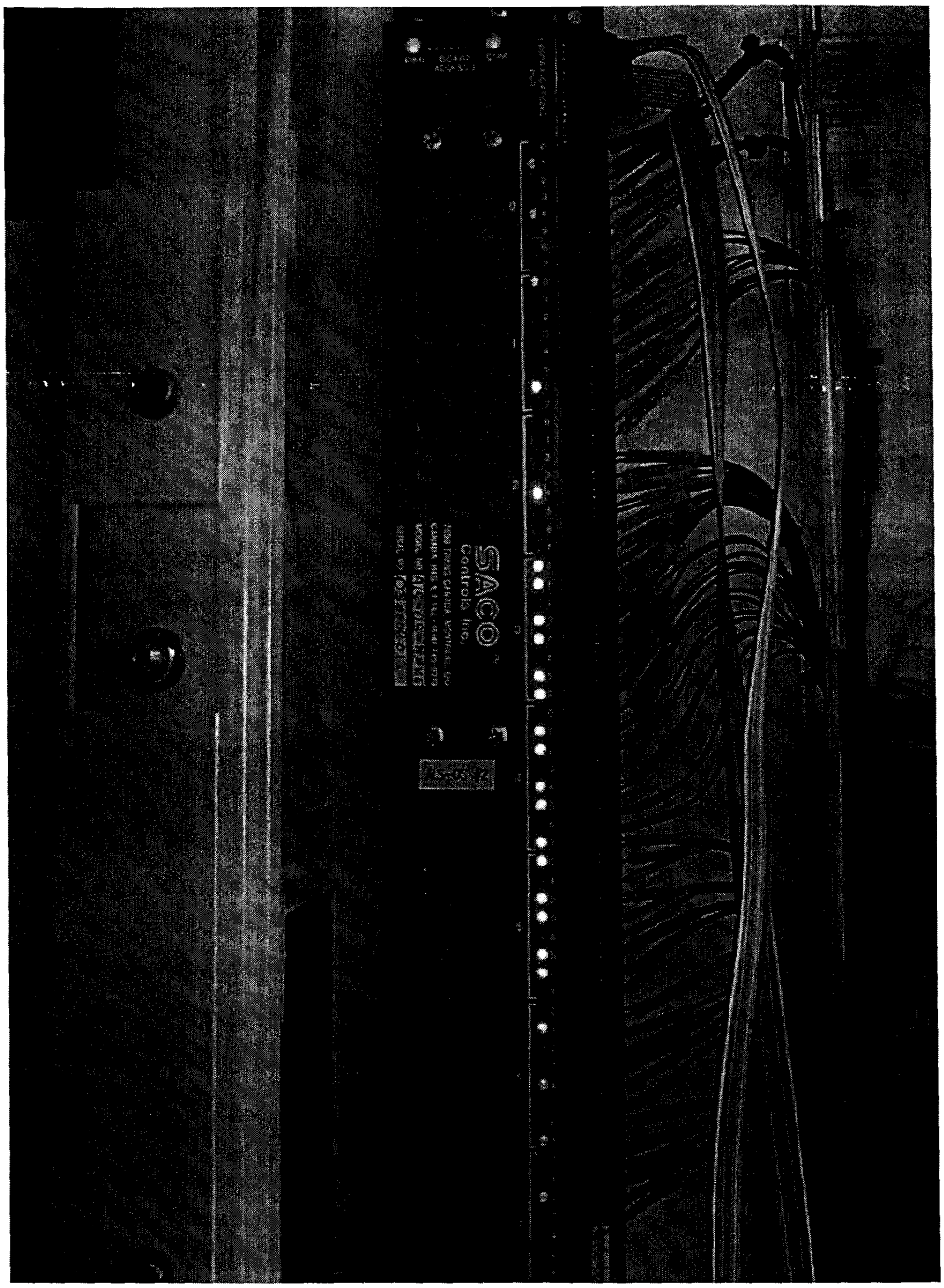
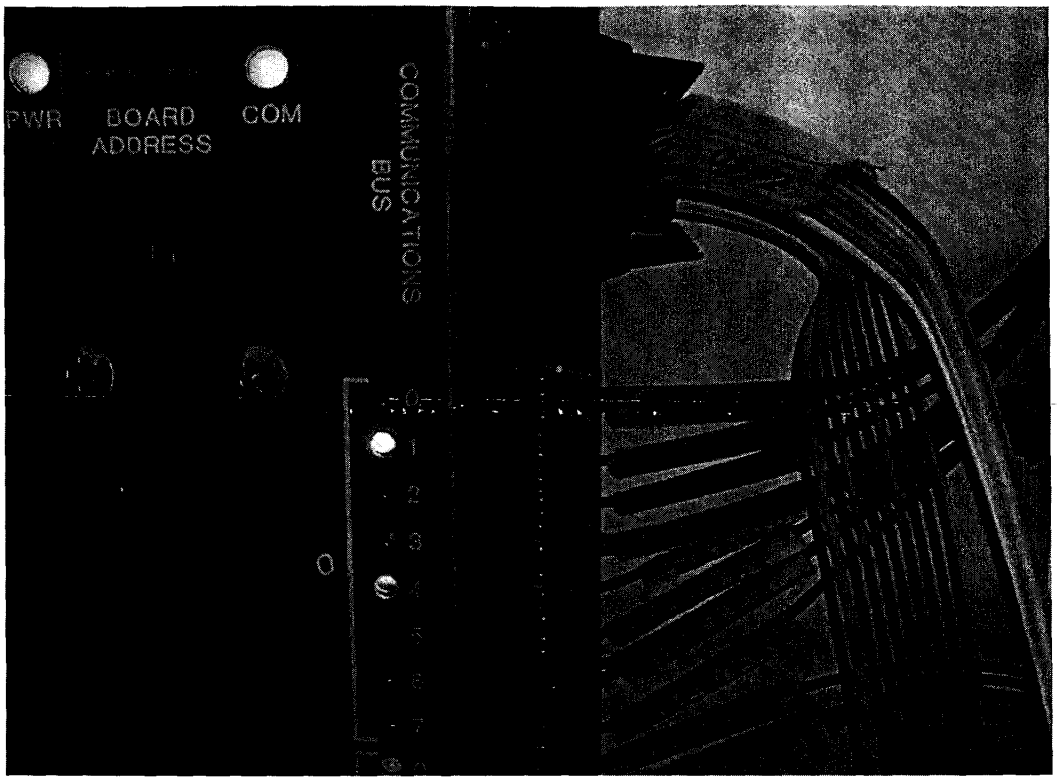
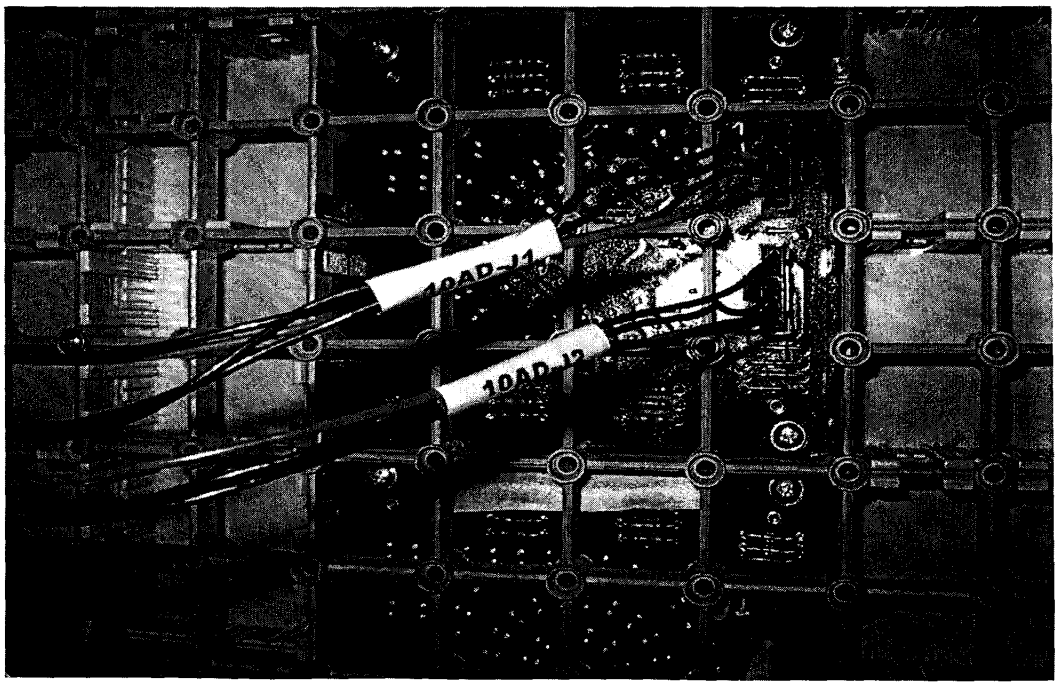

ALS-C
SACO
Controls Inc.

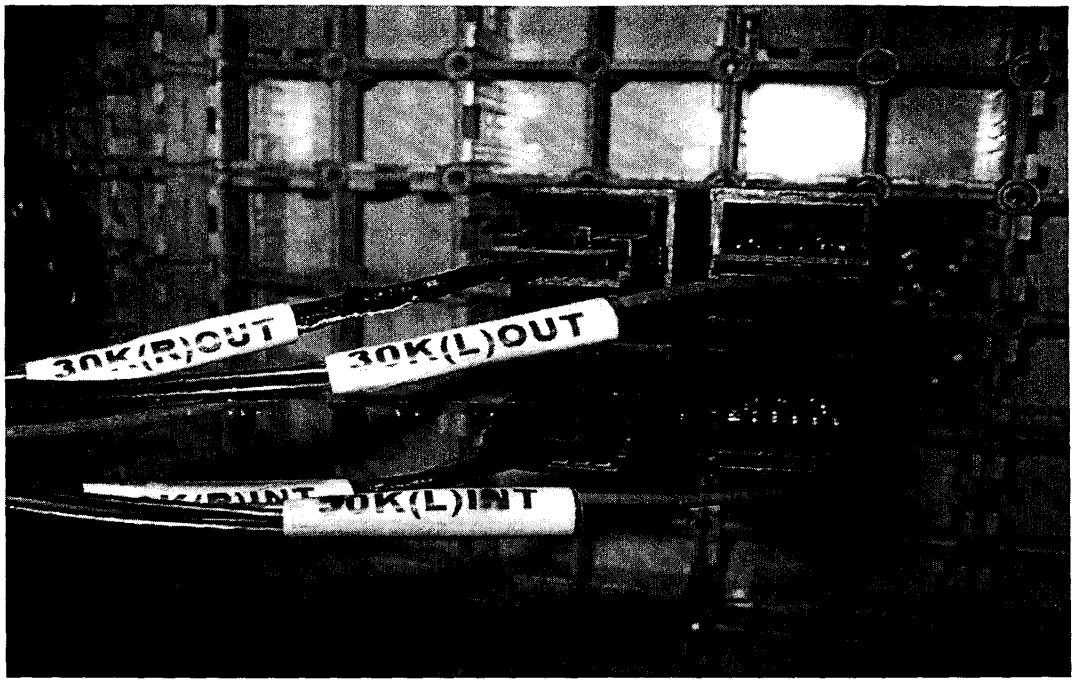


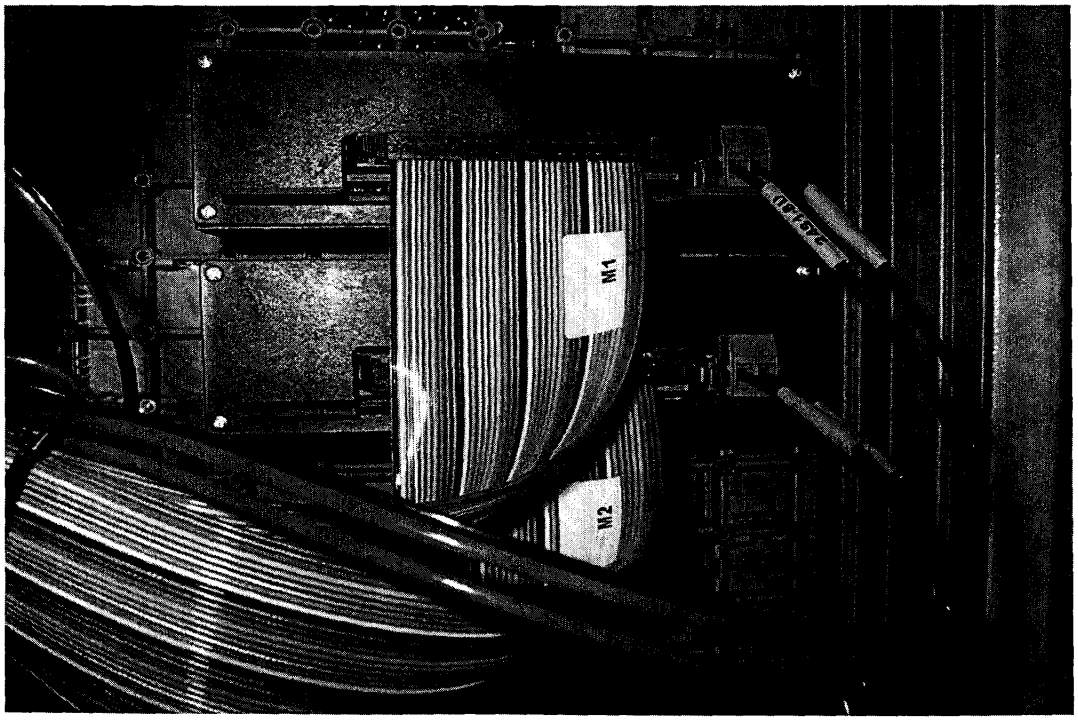

SAGO


SACO
Controls Inc.

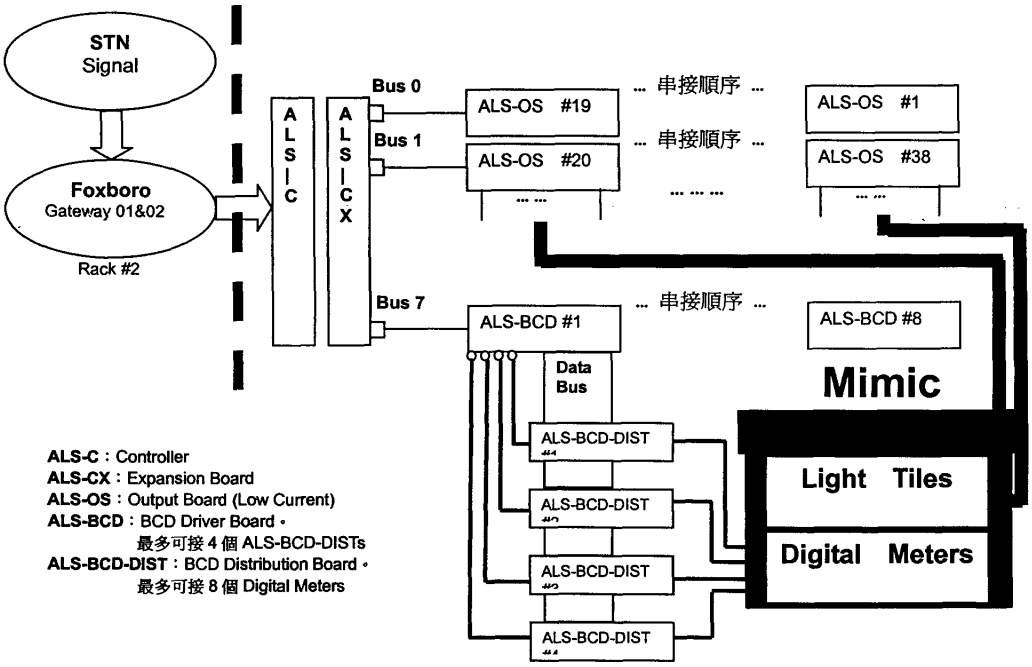

PWR
BOARD ADDRESS
COM
COMMUNICATIONS BUS




30K(L)OUT


M1
M2

SACO公司 Mimic Control 示意圖



核能四廠控制室模擬器 Mimic 部份及 Alarm/Annunciator 部份是由位於加拿大魁北克的 SACO 公司（www.sacocontrols.com）提供。

模擬器 Mimic 系統架構示意圖，如圖所示。

Mimic 控制信號傳送，從 STN 主電腦 LMCC1 送出，經由 Foxboro Gateway-01 及 Gateway-02 傳送到 SACO 公司提供之 ALS-C 控制器。如屬於 Pump、Valve、EDG 等 Light Tiles 的控制信號，則再經由 ALS-OS 分送連接到個別 Light Tiles。如屬於數字型指示表（Digital Meter）的控制信號，則再經由 ALS-BCD 及 ALS-BCD-DIST 分送連接到個別 Digital Meter。

基本上，ALS-C 控制器不會自行啓動顯示控制功能，除非 ALS-C 控制器從主電腦（Host Computer）收到訊息（Message）。當主電腦送一個訊息到 ALS-C 控制器時，ALS-C 控制器將回應以自己的功能訊息以供執行顯示控制。ALS-C 控制器功能訊息內容是由 ASCII 字元字串組成，而以 CR（Carriage Return）及 LF（Line Feed）字元做爲結尾。

功能訊息內容字串格式簡介如下：

功能訊息內容字串之第一個字元表示命令碼(Command)，代表等待執行之事件(Event)。
如下表所示：

Code	Command
0	Turn OFF selected point number
1	Turn ON selected point number
2	SLOW FLASH selected point number
3	FAST FLASH selected point number
4	DIM selected point number
5	MODULATE selected point number
6	Lamp Test and Software System Reset Request
7	Point of System Status Request
8	Lamp Monitor
9	BCD Display Command
;	Group Load Command
:	Group Update Command
>	Input Status Request

命令碼 **6、7、8、9、;、:** 、**>** 之功能訊息摘要格式說明如下：

F[CR][LF]

命令碼 **0、1、2、3、4、5** 之功能訊息摘要格式說明如下：

F_1 F_2 F_3 .....F_n [CR][LF]

F = Function
n = Numbers of functions in a message (max. 256)
[CR] = Carriage Return
[LF] = Line Feed

每一功能訊息段 F 是由一連串 ASCII 字元組成，以空白字元(Space character)爲結尾。

功能訊息格式詳細說明如下：

命令碼 **0、1、2、3、4、5、7、8、>** 如需指定顯示點位址(Display Point Address)，則功能訊息之格式如下：

CVWXYZ[SP]

C = Command code
VWXYZ = 顯示點位址，由八進制 5 個數字組成。
範圍：00000 – 37777 八進制 (0 - 16,384 十進制)
VWX：板位址 (Board Address)
範圍：000 – 377 八進制 (0 - 255 十進制)
例如，017 八進制 (15 十進制)
☞ 第 16 個板
YZ ：點位址 (Point Address)
範圍：00 – 77 八進制 (0 - 63 十進制)
例如，77 八進制 (63 十進制)
☞ 第 64 個點
[SP] = Space character

命令碼 **6**，功能訊息之格式如下：

CWXYZ[SP][CR][LF]
C = Command code, i.e. 6
WXYZ = 序號，由八進制 4 個數字組成。
0000：Exit the lamp test function and restore all points to their original state
0001：Turn ON all ODD points
0002：Turn ON all EVEN points
0006：Turn OFF all points
7777：Turn ON all points and meters

命令碼 **9**，功能訊息之格式如下：

$9FA_2A_1A_0$[SP] $D_1D_2...D_n$[SP][CR][LF]
9 = BCD Display command code
F = BCD Display Control Function
0：Turn display OFF
1：Turn display ON
2：Turn display to SLOW FLASH
3：Turn display to FAST FLASH
$A_2A_1A_0$ = BCD display address, three octal digits
Valid numbers：000 - 777
D = Data to be displayed
n = The nth BCD meter to be changed

命令碼 ；，功能訊息之格式如下：

；$A_2A_1A_0$[SP]$P_1P_2P_3...P_n$ [CR][LF]
； = command code
$A_2A_1A_0$ = Goup address in octal (000 – 377)
P = Point to include into group,
with the following format
VWXYZ[SP]
VWXYZ = Point address in octal
(00000 – 37777)
n = The nth point to include in the group.
The maximum number of point per group is 64.

命令碼 ：，功能訊息之格式如下：

：$U_1U_2U_3...U_n$[CR][LF]
： = command code
U = Group to include for update,
with the following format
C $A_2A_1A_0$[SP]
C = Group Update Control Code (0 – 5)
0：Turn OFF selected group address
1：Turn ON selected group address
2：SLOW FLASH selected group address

3：FAST FLASH selected group address
4：DIM selected group address
5：MODULATE selected group address

$A_2 A_1 A_0$ = Group address in octal (000 – 377)

n = The nth group to include for update within the message

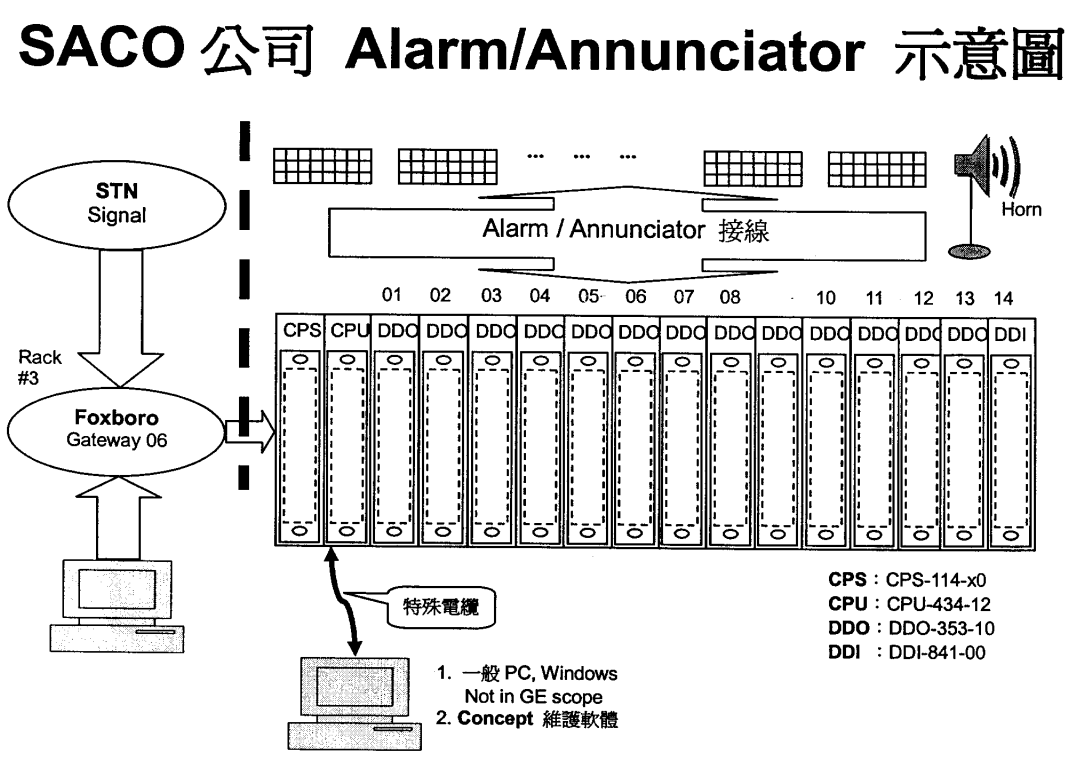
命令碼 **>**，功能訊息之格式如下：

CVWXYZ[SP][CR][LF]

> = Input Status Request command code

VWXYZ = Point address in octal (00000 – 37777)

模擬器 Alarm/Annunciator 系統架構示意圖，如圖所示。



Foxboro WorkStation
(Shift Supervisor Console)
Alarm / Annunciator
Control Displays

Alarm/Annunciator 控制信號傳送，主要是由 Foxboro WorkStation 驅動，經由 Foxboro Gateway-06 傳送到 SACO 公司提供之 CPU module。在 CPU module 內部，控制信號再經過 PLC 控制程式處理，而後連接由 Digital Output module 分送到 Alarm/Annunciator 之燈號 Windows。換言之，PLC 控制程式如果圖形連接設計有誤，縱然 Gateway-06 的輸出信號是正確的，但 Alarm/Annunciator 的燈號 Windows 顯示仍會是錯誤的。於 Shift Supervisory Console 之 Foxboro WorkStation 亦提供 Alarm/Annunciator 之設計控制測試之畫面（例如，Slow Flash、Fast Flash、Static、Dynamic、Light Color 等）。

CPU module 內部之 PLC 控制程式是利用 CONCEPT 圖形套裝軟體針對核能四廠應用規劃設計，將 Alarm/Annunciator 分割成數個 Section。於測試完成後，再將 Alarm/Annunciator 設計資料分 Section 逐一 Compile 成執行檔，再從 PC 下載（Download）

到 CPU module 以供執行控制。

CONCEPT 是一種 Microsoft Windows-based 可程式化的工具，可於單一發展環境下，提供控制系統不同種類控制程式（例如，BASIC、FORTH、C 等）的結構化設計、測試、診斷、建立並整合 PLC 控制程式、通訊控制及診斷功能於相同的資料庫。此外，亦可將複合程式（Complex program）簡化成階層式結構（Hierarchical structure），使易於閱讀。

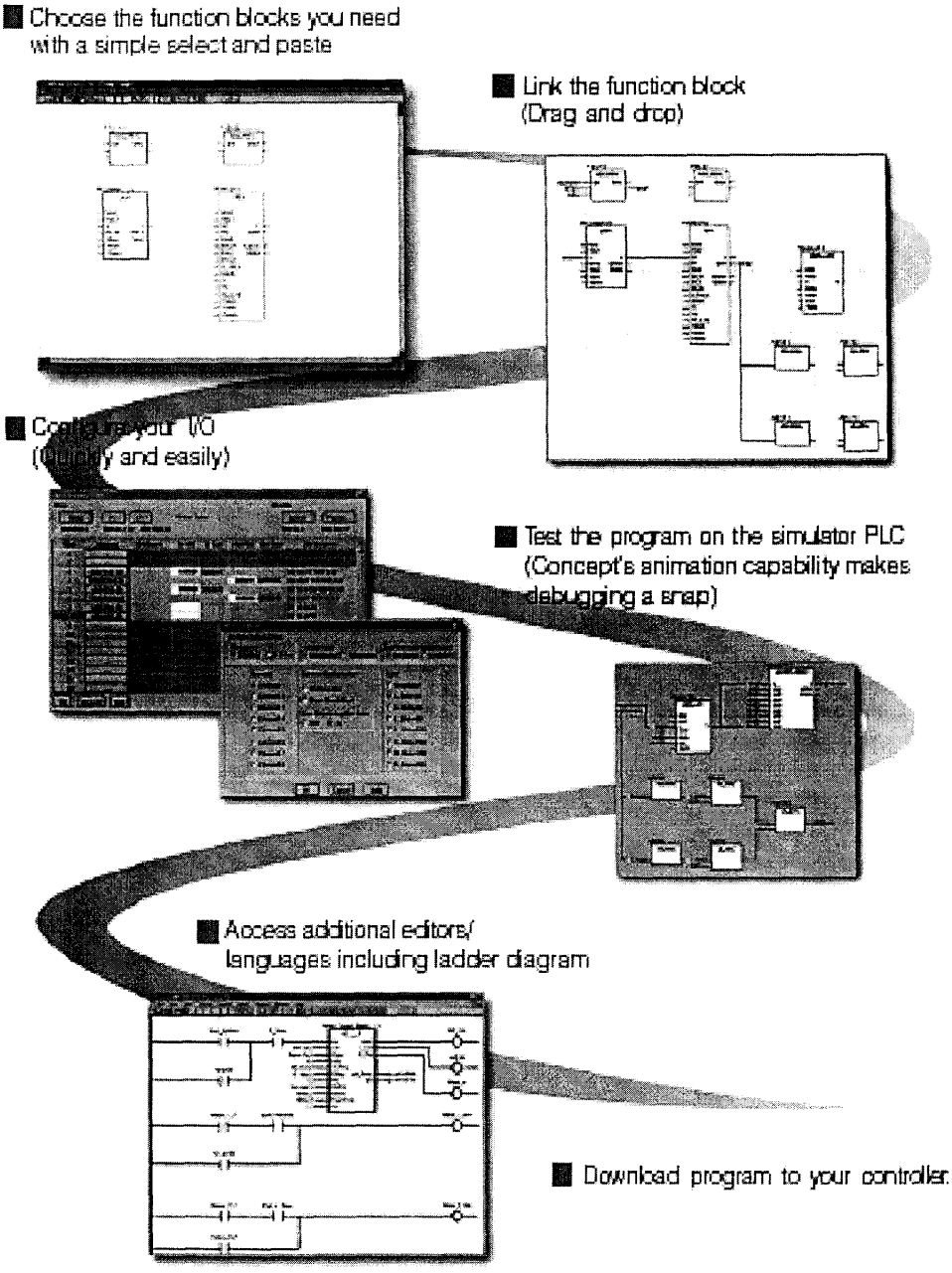
CONCEPT 控制程式發展流程 Life Cycle 如圖所示。

CONCEPT符合IEC1131-3(Full title IEC61131-3)國際標準PLC程式控制語言(IEC1131-3敘述PLC語言程式LD - Ladder Diagram、SFC - Sequential Function Charts、FBD - Function Block Diagram、ST - Structured Text、IL - Instruction List等五項之Syntax、Semantics及Display)。提供通用圖形使用者介面，使用標準化的編輯器（Editor），提供構型（Configuration）、開發、除錯、安裝前模擬測試、系統擴充、線上監控與更改等功能，並簡化 Modicon TSX Quantum Automation Series control system之程式編寫、文件管理列印，維護容易。同時CONCEPT之可攜性（Portability）支援IEC格式，亦可建立可重覆使用（Re-usability）的程式庫（Program Library），亦可購買加入Third-party之程式模組。

Alarm/Annunciator 燈號 Windows 維護診錯時，則須利用特殊電纜連接 PC 與 CPU module 之通訊埠，先行將最新控制資料從 CPU module 上載（Upload）到 PC 端供 CONCEPT 軟體使用，再進行維護偵錯。

Digital Input module 目前並未有控制信號連接。

Concept — Quick, Easy and Efficient Way to Build Your Application



V. 核四廠 Annunicator 設備介紹

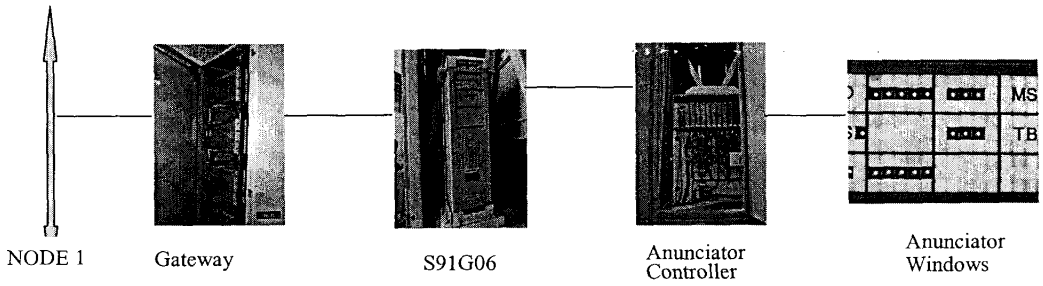
一、系統概述:

Annunicator 採用 Modicon TSX Quantum Automation Series, 本系統有數位處理計算的能力，它用在即時控制上，可以依需要使模組化的擴充。

本設備有下列元件:

1. Quantum series CPU 434-12A
2. DDO 353-10 modules
3. CPS 114-10 Power Supply

二、系統架構:



三、應用軟體

本系統採用 Concept V2.1 軟體

Concept V2.2

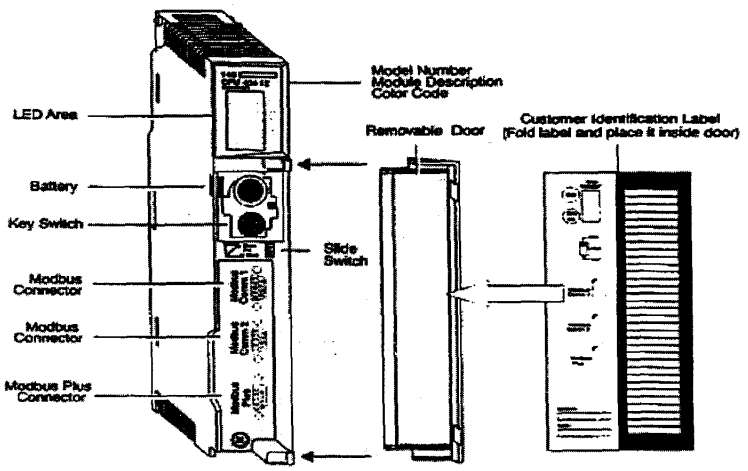
This document contains the following sections:

1. Overview
2. System Requirements
3. Information about Concept 2.2
3.1. Concept and Service Release Installation
3.2. MMFStart Installation
3.3. New Projects
3.4. Project Conversion
4. Further Information
4.1 General
4.2 Language specific
4.3 Simulator
4.4 Hardware related Issues
5. Known Issues
6. Technical Support
7. Copyright Notes

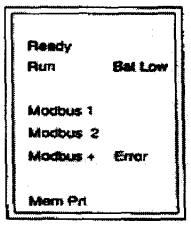
四、元件描述:

1. Quantum series CPU 434-12A

4.4.5.1 140 CPU 434 12 and 140 CPU 534 14 Modules

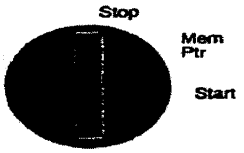


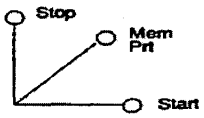
CPU LED Indicators and Descriptions



LEDs	Color	Indication when On
Ready	Green	The CPU has passed power up diagnostics.
Run	Green	The CPU has been started and is solving logic.
Bat Low	Red	The battery needs replacing or is not present.
Modbus 1	Green	Communications are active on the Modbus port 1.
Modbus 2	Green	Communications are active on the Modbus port 2.
Modbus +	Green	Communications are active on the Modbus Plus port.
Error	Red	Indicates communications error on the Modbus Plus port.
Mem Prt	Amber	Memory is write protected (the memory protect switch is on).

Key Switch
The key switch is used to protect memory from programming changes while the controller is in operation.





Note: The key switch positions shown next to the switch (above) are for reference only and are marked on the module as indicated on the right.

Key switch Position	Controller Status	Memory Protected From Programmer Changes	Will Accept Programmer Stop or Start	Key switch Transition
Stop	Controller is stopped and disables Programmer changes	Y	N	**From Start or Memory Protect:** Stops controller, if running, and disables Programmer changes
Mem Prt	Controller may be either stopped or running and Programmer changes are disabled	Y	N	**From Stop or Start:** Prevents Programmer changes, controller run status is not changed
Start	Controller may be either stopped or running. Programmer may make changes and start/stop the controller	N	Y	**From Stop:** Enables Programmer changes, starts controller. **From Memory Protect:** Enables programmer changes, starts controller if stopped

140 CPU 424 02, 140 CPU 434 12 and 140 CPU 534 14 Run LED Error Codes

Number of Blinks	Code	Error
Continuous	0000	requested Kernel mode
2	0201	modbus cmd-buffer overflow
	0202	modbus cmd-length is zero
	0203	modbus abort command error
	0204	run output active failed
	0205	bad mbp response opcode
	0206	mbp out of synchronization
	0207	mbp invalid path
	0208	page 0 not paragraph aligned
	0209	bad receive comm state
	020A	bad transmit comm state
	020B	bad comm state tm_asc
	020C	bad comm state tm_rtu
	020D	bad comm state rcv_rtu
	020E	bad comm state rcv_asc
	020F	bad modbus state tmr0_evt
	0210	bad modbus state tm-int
	0211	bad modbus state rcv-int
	0212	stack error in MB cmd hndlr
	0213	host ifc opcode unknown
	0214	host ifc diagnostic failed
	0215	host addr xlat error
3	0301	bus grant not received
	0302	not master asic on cpu
	0303	master config write bad
	0304	lms bus DPM write failure
	0305	plc asic loopback test asic/dpm
	0306	plc asic BAD_DATA
4	0401	P.O.S.T BAD MPU ERROR
	0402	BAD INTERRUPT
	0403	ram error during sizing
	0402	mbp bus interface error
	0405	timeout waiting for mbp
	0406	bad external uart hardware
	0407	bad external uart interrupt
	0408	bad RTC hardware
5	0501	ram address test error
6	0601	ram data test error
7	0701	bad executive checksum
8	8001	kernel prom checksum error
	8002	flash prog / erase error
	8003	unexpected executive return
	8004	unexpected int1
	8014	divide error
	8024	debug exception
	8034	breakpoint
	8044	overflow
	8054	bounds fault
	8064	invalid opcode

2. DDO 353-10 modules

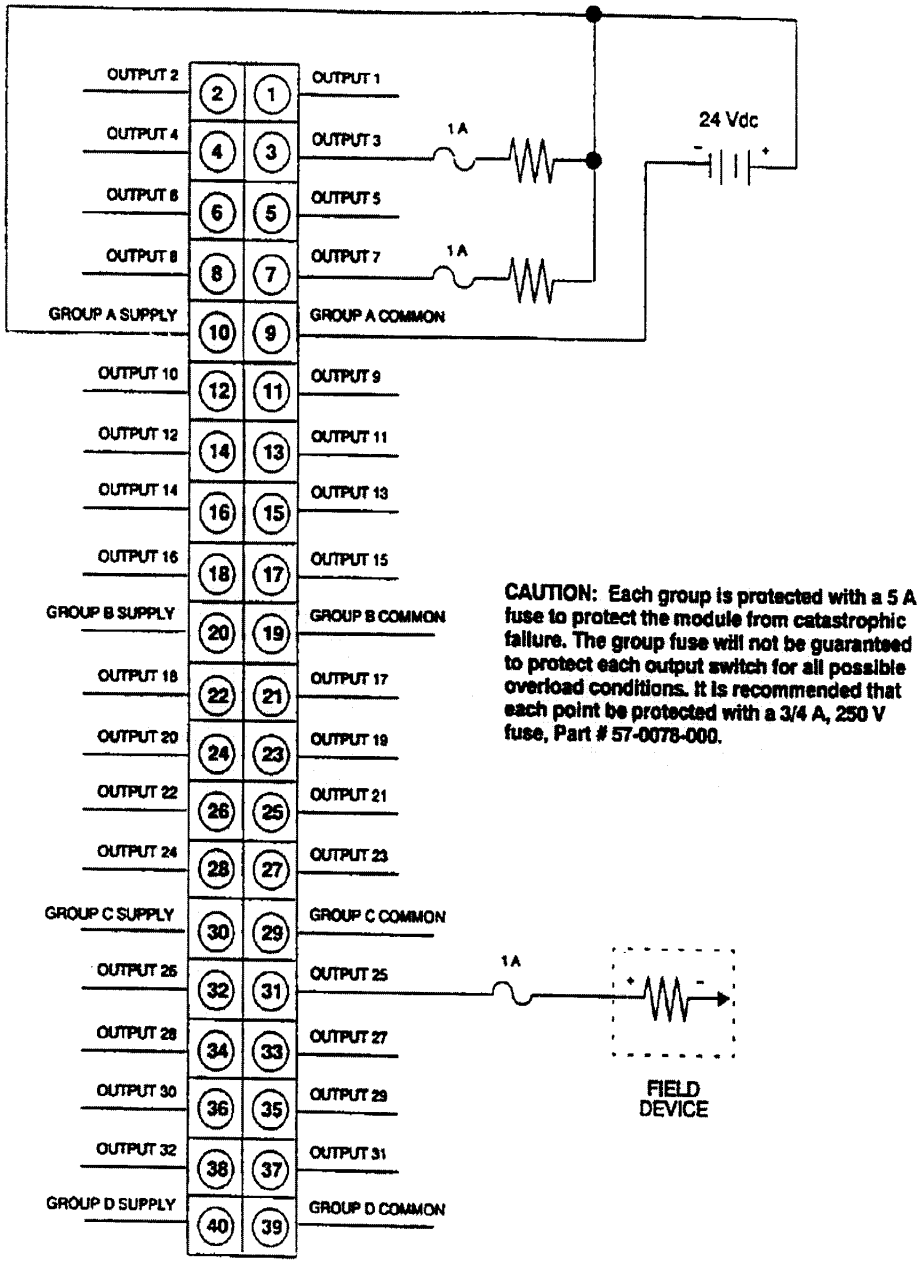
所有 Quantum I/O 模組對匯流排均採用光電隔離(optical isolated)，以確保安全和 Trouble- free 操作，而且所有 I/O module 均是 software configurable。
下列爲本卡片之規範及接線方式:

140 [redacted]
DDO 353 10
24 VDC OUT SINK

The **24 Vdc True Low 4x8 Output** module switches 24 Vdc loads capable of driving displays, logic, and other loads up to 500 mA sinking in the ON state.

Specifications

Number of Output Points	32 output points in four 8 point groups
LEDs	Active F 1 ... 32 (Green) - Indicates point status
Required Addressing	2 Words Out
Voltage	
Operating (max)	19.2 ... 30 Vdc
1.0 ms	50 Vdc decaying pulse
ON State Drop / Point	0.4 Vdc @ 0.5 A
Maximum Load Current	
Each Point	0.5 A
Each Group	4 A
Per Module	16 A
OFF State Leakage/Point	0.4 mA @ 30 Vdc
Surge Current Maximum	
Each Point	5 A @ 1 ms duration (no more than 6 per minute)
Response (Resistive Loads)	
OFF - ON	1 ms (max)
ON - OFF	1 ms (max)
Fault Detection	Blown fuse detect, loss of field power
Isolation	
Group to Group	500 Vac rms for 1 minute
Output to Bus	1780 Vac rms for 1 minute
Load Inductance Maximum	0.5 Henry @ 4 Hz switch frequency or $L = \frac{0.5}{I^2 F}$ where: L= Load Inductance (Henry) I = Load Current (A) F = Switching Frequency (Hz)
Load Capacitance Maximum	50 ΠF
Tungsten Load Maximum	12 W @ 24 Vdc
Output Protection (internal)	Transient voltage suppression: 36 V



CAUTION: Each group is protected with a 5 A fuse to protect the module from catastrophic failure. The group fuse will not be guaranteed to protect each output switch for all possible overload conditions. It is recommended that each point be protected with a 3/4 A, 250 V fuse, Part # 57-0078-000.

140 DDO 353 10 Wiring Diagram

3. CPS 114-10 Power Supply

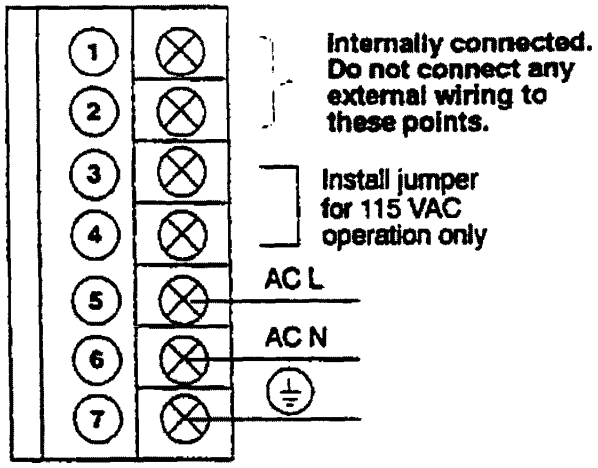
140 [redacted]
CPS 114 10
PS 115/230 VAC SUM

AC Summable Power Supply, 115/230 Vac, 8 A

Specifications

Input Requirements	
Input Voltage	93 ... 138 Vac 170 ... 276 Vac
Input Frequency	47 ... 63 Hz
Input Voltage Total Harmonic Distortion	Less than 10% of the fundamental rms value
Input Current	1.1 A @ 115 Vac 0.6 A @ 230 Vac
Inrush Current	38 A @ 115 Vac 19 A @ 230 Vac
VA Rating	130 VA
Input Power Interruption	1/2 cycle @ full load & minimum rated line voltage / frequency. No less than 1 second between interruptions.
Fusing (external)	2.0 A slo-blo recommended (Part # 57-0089-000 or equivalent)
Output to Bus	
Voltage	5.1 Vdc
Maximum Current	8 A @ 60°C
Minimum Current	None required
Protection	Over Current, Over Voltage
General	
Field Wiring Connector (included)	7 point terminal strip (Part # 043506326)
Internal Power Dissipation	6.0 + 1.5 x I_{OUT} = Watts (where I_{OUT} is in Amperes)

Operating Mode	Standalone / Summable



140 CPS 114 10 Wiring Diagram *

VI. 主控制室控制盤各操作螢幕均配有電腦並賦予位址:

Foxboro 部分之電腦定址爲

```
#*****************************************************
#   EWI NETWORK GE LUNGMAN
#*****************************************************
152.152.152.101   P2S91001
152.152.152.102   P2S91002
152.152.152.103   P2S91003
152.152.152.104   P2S91004
152.152.152.105   P2S91005
152.152.152.106   P2S91006
152.152.152.108   P2S91008
152.152.152.109   P2S91009
152.152.152.10    P2S91010
152.152.152.11    P2S91011
152.152.152.12    P2S91012
152.152.152.13    P2S91013
152.152.152.14    P2S91014
152.152.152.15    P2S91015
152.152.152.16    P2S91016
152.152.152.17    P2S91017
152.152.152.18    P2S91018
152.152.152.19    P2S91019
152.152.152.20    P2S91020
152.152.152.21    P2S91021
152.152.152.22    P2S91022
152.152.152.23    P2S91023
152.152.152.24    P2S91024
```

```
152.152.152.25    P2S91025
152.152.152.26    P2S91026
152.152.152.27    P2S91027
152.152.152.28    P2S91028
152.152.152.29    P2S91029
152.152.152.30    P2S91030
152.152.152.31    P2S91031
152.152.152.32    P2S91032
152.152.152.33    P2S91033
152.152.152.34    P2S91034
152.152.152.35    P2S91050
152.152.152.51    P2S91051
152.152.152.52    P2S91052
152.152.152.53    P2S91G04
152.152.152.150   P2S91G03 Barco
152.152.152.61    P2S74001
152.152.152.62    P2S74002
152.152.152.63    P2S74302
152.152.152.64    P2S74202
152.152.152.65    P2S74102
152.152.152.66    P2S74050
152.152.152.67    P2RAS
152.152.152.68    P2S74101
152.152.152.69    P2S74201
152.152.152.70    P2S74301
152.152.152.71    P2S74401
152.152.152.72    P2S74103
152.152.152.73    P2S74203
152.152.152.74    P2FOXREMPC1
152.152.152.76    P2S74303
152.152.152.93    P2S91053
152.152.152.151   P2S91060 EWI
# Remote Clients for station S91062
152.152.152.152   P2S91062A
152.152.152.153   P2S91062B
152.152.152.154   P2S91062C
152.152.152.155   P2S91062D
152.152.152.156   P2S91062E
152.152.152.157   P2S91062F
152.152.152.158   P2S91062G
#
#
151.128.8.102 S91001
151.128.8.91  S91002
151.128.8.92  S91003
151.128.8.93  S91004
151.128.8.94  S91005
151.128.8.95  S91006
151.128.8.96  S91008
151.128.8.97  S91009
151.128.8.99  S91010
151.128.8.98  S91011
151.128.8.65  S91012
151.128.8.75  S91013
151.128.8.76  S91014
```

```
151.128.8.90  S91015
151.128.8.77  S91016
151.128.8.78  S91017
151.128.8.79  S91018
151.128.8.80  S91019
151.128.8.81  S91020
151.128.8.82  S91021
151.128.8.83  S91022
151.128.8.84  S91023
151.128.8.85  S91024
151.128.8.86  S91025
151.128.8.68  S91026
151.128.8.87  S91027
151.128.8.88  S91028
151.128.8.67  S91029
151.128.8.74  S91030
151.128.8.73  S91031
151.128.8.72  S91032
151.128.8.71  S91033
151.128.8.70  S91034
151.128.8.66  S91050
151.128.8.101 S91051
151.128.8.100 S91052
151.128.8.104 S91055
151.128.8.105 S91056
151.128.8.89  S91062
151.128.8.69  S91G04
151.128.8.72  S74001
151.128.8.76  S74002
151.128.8.78  S74050
151.128.8.71  S74101
151.128.8.74  S74102
151.128.8.65  S74103
151.128.8.70  S74201
151.128.8.73  S74202
151.128.8.77  S74203
151.128.8.69  S74301
151.128.8.75  S74302
151.128.8.67  S74303
151.128.8.68  S74401
151.128.8.66  S91053
#
#*****************************************************
# End of I/A hosts
#*****************************************************
```

VII. AOS MAP 檔維修與測試

爲改善 AOS Sun Workstation 的運作效能及易於維護，.aod files 通常集中置放於一目錄中，重新執行 MkMapFile：

Map file generation: */opt/aos/scripts/MkMapFile 1G41*
Object type definition: */opt/aos/22sys/data/ObjTemplates/*
Object instance specification: */opt/aos/22sys/data/1G41.aod*

再將所有產生的 map files 置於一目錄中，並重新安排 aosBuild / aosMap script file，或配合使用 AppObjSrv 來 load .map files，再使用 aoGet， aoSet 或 omget，omset 確認已正確 load mapping file：

```
omset –Pb ox2000 1G41:P0001_M1.PAKCRB
omget 1G41:MBV0016_M1.PAKCRB
aoGet 1G41:FT0006A.PNT
```

VIII. 測試 panel I/O (RTP)

Transition from Freeze mode to PanelTest mode.
Building ptt display, please wait
>>
Time: 09:17:19
Date: 2002-11-23
Help
Deploy
Previous Disp
Pan&Zoom
StopUpdate
Commands
Utilities
End Session
Snapshot
Load IC
BC Mode
Status
PanelTest
SysPara
Marks
Remks
Ovrds
Trigger
Snap IC
Load IC
Current IC
Copy IC
Delay Clock
Simulation time
Stop
Panel Test Tableau
PTT
Start Panel-Testprogram
on SIMHOST
Panel-Testprogram
Test Exit
lmsimu lmis 2002-11-23 09:17 AM

```
21.06.02 R4.2          Panel Function Test Program I O _ T E S T
                                STN ATLAS Elektronik BREMEN
                                      NUKS LUNGMEN
-------------------------------------------------------------------------------

    1 = DI-Test          2 = DO-Test(Panloc)      6 = AO-Test(Panloc)
                           3 = DO-Test(Pin)         7 = AO-Test(Pin)
                           4 = DO-Test(Plug)        8 = AO-Test(Plug)
                           5 = DO-Test(Section)     9 = AO-Test(Section)
                                                      m = AO-Test(Ramp Meter)



                                  l = DO Light Show



                                  # = Exit

-------------------------------------------------------------------------------
  Input:
```

```
21.06.02 R4.2          Panel Function Test Program I O _ T E S T
                                STN ATLAS Elektronik BREMEN
                                      NUKS LUNGMEN

                                      PANEL-DI TEST
-------------------------------------------------------------------------------
Scanning through PANEL_DI for 1233   DI's                                  1233

  Panloc          :.MC03CQ231_B01.....Offset :.PNDI00205.....

  MPL             :.(1N21-CTS-4608).....

  Description :.CBP D STOP.....

  Distributor :.CM02/B.....Plug     :.NO1CHA1SLO09CM02.....Pin/Chan :.DI08/7....

  HW Element   :.1702/B_AK/C.....

  Lamp            :.(1N21-CTS-4608).....OFF.....
```

Description :.CBP D STOP.....

Hit Ctrl-C to stop DI-TEST

21.06.02 R4.2 Panel Function Test Program I O _ T E S T

STN ATLAS Elektronik BREMEN

NUKS LUNGMEN

DO-PANLOC TEST - Sorted by PANLOC

Scanning through PANEL_DO for 354 DO's DO Number: 1

Panloc :.MC01CO312_L01.....Offset :.PNDO00000.....

MPL :.(1C51-PB-4608).....

Description :.MRBM SYS SETUP PERMIT A ON.....

Distributor :.CM01/A.....Plug :.NO1CHA3SLO14CM01.....Pin/Chan :.DO20/0....

HW Element :.1701/A_AD/A.....

f=Forward b=Back p=Panloc t=Blinking(off) e=Error to File #=Exit

---

Enter [f/b/p/t/e/#]:.

21.06.02 R4.2 Panel Function Test Program I O _ T E S T

STN ATLAS Elektronik BREMEN

NUKS LUNGMEN

AO-PAN TEST - Sorted by PANLOC

Scanning through PANEL_AO for 83 AO's AO-Number: 1

Panloc :.RS01BE156_A01.....Offset :.PNAO00000.....

MPL :.1P21-TE-0011A2:1C61-TI-2135A.....

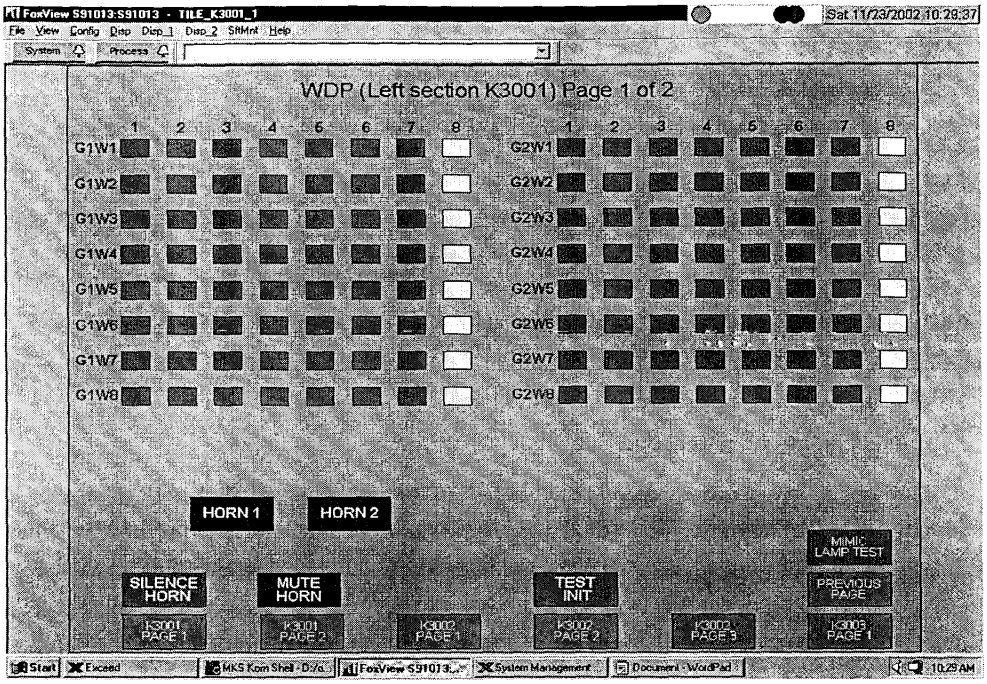
Description :.RHR HX 1A - RBCW INLET TEMP.....

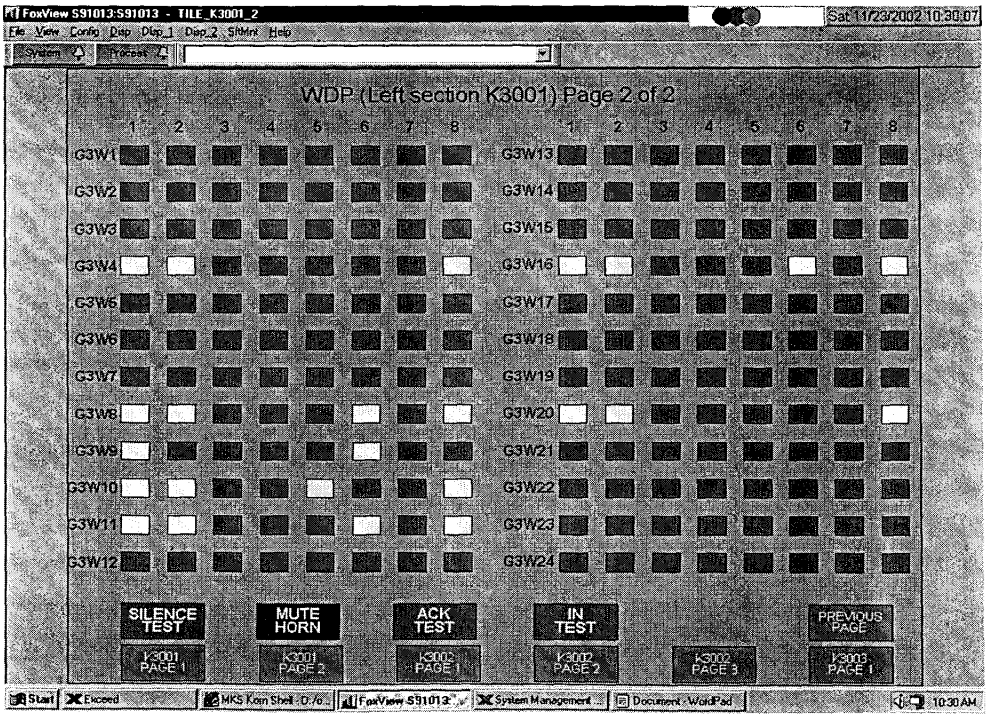
Distributor :.CM06/A.....Plug :.NO2CHA1SLO14CM06....Pin/Chan :.AO13/0....

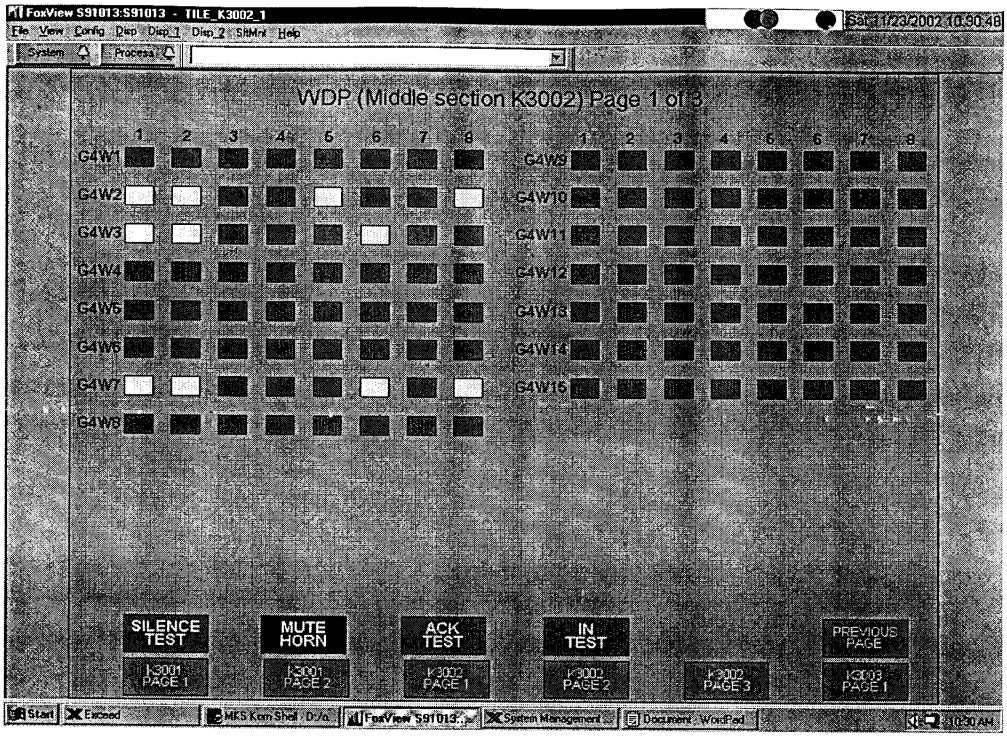
HW Element :.3001_BZ/A.....

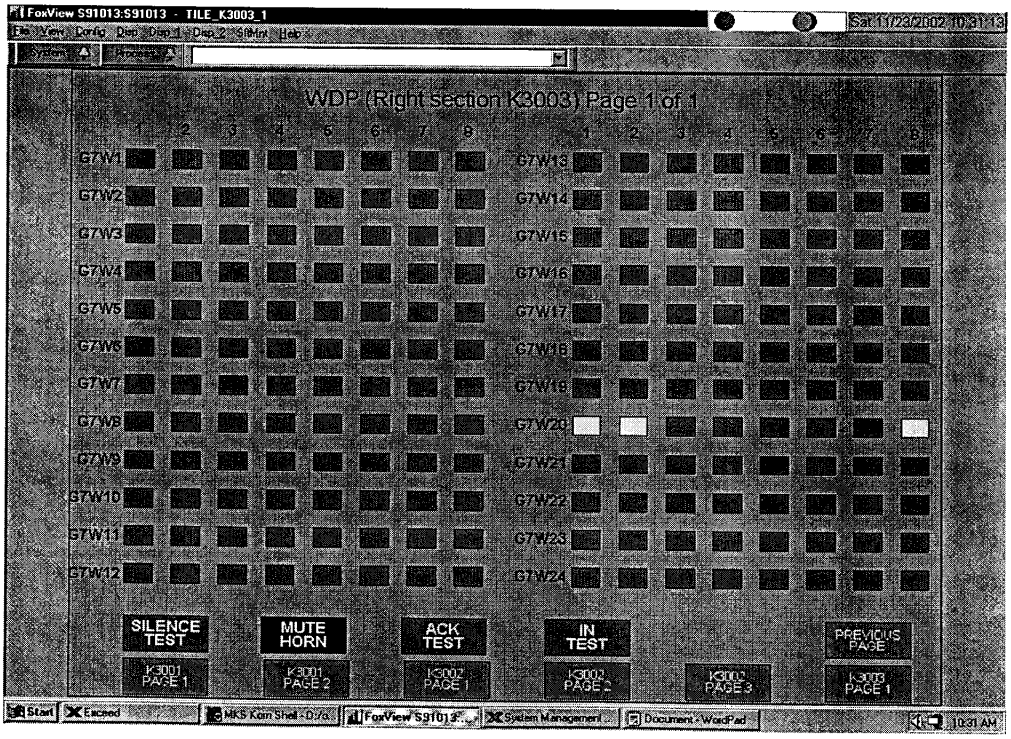
```
   Minimum        :.0.....Maximum :.50.....Units      :.C.....

   Set Value(%):.50.0.....

f=Forward b=Back p=Panloc k=Coef(%) e=Error to file #=Exit
--------------------------------------------------------------------------------
Enter [f/b/p/k/e/#]:
```

IX. 測試 Alarm&Annunciator Tiles 操作畫面






FoxView S91013:S91013 - TILE_K3002_1
Sat 11/23/2002 10:30:48
WDP (Middle section K3002) Page 1 of 3
SILENCE TEST
MUTE HORN
ACK TEST
IN TEST
PREVIOUS PAGE
K3001 PAGE 1
K3001 PAGE 2
K3002 PAGE 1
K3002 PAGE 2
K3002 PAGE 3
K3003 PAGE 1
10:30 AM


FoxView S91013:S91013 - TILE_K3003_1
Sat 11/23/2002 10:31:13
WDP (Right section K3003) Page 1 of 1
SILENCE TEST
MUTE HORN
ACK TEST
IN TEST
PREVIOUS PAGE
K3001 PAGE 1
K3001 PAGE 2
K3002 PAGE 1
K3002 PAGE 2
K3002 PAGE 3
K3003 PAGE 1
10:31 AM

X. 測試 STN 電腦之能力與容量:

```
root@lmcc1{4}/>df
Filesystem                    512-blocks      Used   Available Capacity
Mounted on
root_domain#root                  800000    319142      465568    41%    /
/proc                                  0         0           0   100%
/proc
usr_domain#usr                    4000000   1486962     2475744    38%
/usr
var_domain#var                     600000    142044      443040    25%
/var
rz0f_dmn#local                    2000000    347234     1636752    18%
/usr/local
rz0g_dmn#nsr                      6000000      1884     5984608     1%
/nsr
rz1a_dmn#lmccsimu                 4000000   2495050     1492704    63%
/lungmen/lmccsimu
rz1d_dmn#db                      10000000   5247652     4737184    53%
/lungmen/lmccsimu/db
/dev/rz1b                         7760780   2826982     4157720    41%
/lungmen/lmccsimu/data
/lungmen/intgr/process@lmpdm     23773520  12679220    10695216    55%
/lungmen/intgr/process
/lungmen/intgr/control@lmpdm     23773520  12679220    10695216    55%
/lungmen/intgr/control
/home/glc/bin@lmpdm               4000000   2520132     1450608    64%
/home/glc/bin
root@lmcc1{5}/>

 root@lmcc1{2}/>disklabel -r rz0
# /dev/rrz0a:
type: SCSI
disk: BD0186459A
label:

flags:
bytes/sector: 512
sectors/track: 254
tracks/cylinder: 20
sectors/cylinder: 5080
cylinders: 7001
sectors/unit: 35565080
rpm: 10025
interleave: 1
```

```
trackskew: 88
cylinderskew: 82
headswitch: 0           # milliseconds
track-to-track seek: 0  # milliseconds
drivedata: 0

8 partitions:
#          size     offset    fstype   [fsize bsize   cpg]      # NOTE: values
not exact
  a:     800000          0     AdvFS                            # (Cyl.    0 -
157*)
  b:     600000     800000      swap                            # (Cyl.
157*- 275*)
  c:   35565080          0    unused        0     0             # (Cyl.    0 -
7000)
  d:    4000000    1400000     AdvFS                            # (Cyl.
275*- 1062*)
  e:     600000    5400000     AdvFS                            # (Cyl. 1062*-
1181*)
  f:    2000000    6000000     AdvFS                            # (Cyl. 1181*-
1574*)
  g:    6000000    8000000     AdvFS                            # (Cyl. 1574*-
2755*)
  h:          0          0    unused        0     0             # (Cyl.    0 -
-1)
root@lmcc1{3}/>

root@lmcc1{3}/>disklabel -r rz1
# /dev/rrz1a:
type: SCSI
disk: BD018645
label:
flags: dynamic_geometry
bytes/sector: 512
sectors/track: 254
tracks/cylinder: 20
sectors/cylinder: 5080
cylinders: 7001
sectors/unit: 35565080
rpm: 10025
interleave: 1
trackskew: 88
cylinderskew: 82
headswitch: 0           # milliseconds
```

```
track-to-track seek: 0  # milliseconds
drivedata: 0

8 partitions:
#          size     offset    fstype   [fsize bsize   cpg]      # NOTE: values
not exact
  a:     4000000          0     AdvFS                           # (Cyl.    0 -
787*)
  b:     8000000    4000000    4.2BSD     1024  8192    16      # (Cyl.
787*- 2362*)
  c:    35565080          0    unused        0     0           # (Cyl.    0 -
7000)
  d:    10000000   12000000     AdvFS                           # (Cyl. 2362*-
4330*)
  e:     1000000   22000000      swap                           # (Cyl. 4330*-
4527*)
  f:           0          0    unused        0     0           # (Cyl.    0 -
-1)
  g:           0          0    unused        0     0           # (Cyl.    0 -
-1)
  h:           0          0    unused        0     0           # (Cyl.    0 -
-1)
root@lmcc1{4}/>
```

```
+------R S M M------+
| * s - Task Summary|
| * t - Single Task |
| * o - Options     |
| * r - Reset Values|
| * q - Quit        |
|                   |
|                   |
+-------------------+
```

R S M M Task Summary (all times in ms)

Task	Freq [Hz]	CPU	Time last cyc elapse	Time last cyc cpu	Time last sec elspse	Time last sec cpu	Time last min elapse	Time last min cpu	CPU Time Average	Lost Cycles
tskhdl	16	00	0.0	0.0	0.0	0.0	35.2	0.0	0.00	
-261										
sctlcp	16	01	0.0	0.0	0.0	0.0	0.0	0.0	0.00	
-										
cs_ais	16	01	163.1	1.0	832.0	1.0	51863.3	2.9	0.01	
0										
sctlap	4	01	0.0	0.0	0.0	0.0	0.0	0.0	0.17	
-										
modela	8	08	7.8	7.8	0.0	0.0	0.0	0.0	5.87	
0										
modelb	8	02	88.9	89.0	0.0	0.0	0.0	0.0	91.35	
0										
modelc	8	08	7.8	0.0	0.0	0.0	0.0	0.0	0.13	
0										
modeld	8	08	32.2	24.3	0.0	0.0	0.0	0.0	22.96	
0										
lu_server	4	04	5.9	5.8	4037.1	883.2	4037.1	883.2	4.81	
0										
pra_lugm	4	04	1.0	0.0	189.5	0.0	189.5	0.0	0.00	
-										
snd_serve	4	04	task has not recognized RSMM							

Commands : c - cancel, p - print

```
lmccsimu@lmcc1{54}/lungmen/lmccsimu/conf>vmstat
Virtual Memory Statistics: (pagesize = 8192)
  procs     memory          pages                            intr         cpu
  r  w  u   act   free wire fault cow zero react pin pout   in   sy   cs  us  sy  id
```

```
  6 171 39    56K  37K  33K   7M   1M   2M  495   1M   30 211  4K  1K   8   0
92
lmccsimu@lmcc1{55}/lungmen/lmccsimu/conf>vmstat -M

Memory usage by bucket:

bucket#  element_size  elements_in_use  elements_free  bytes_in_use
fail_nowait
     0            16            47518          13410        760288       0
     1            32            17799           2937        569568       0
     2            64             2929           3087        187456       0
     3           128             2521           1319        322688       0
     4           256              770           1278        197120       0
     5           512             4396            324       2250752       0
     6          1024               13            259         13312       0
     7          2048              158            146        323584       0
     8          4096               19             19         77824       0
     9          8192              105             33        860160       0
    10         16384                4             16         65536       0
    11         32768                7              0        229376       0
    12         65536               17              0       1114112       0
    13        131072                2              0        262144       0
    14        262144                0              0             0       0
    15        524288                3              0       1572864       0
    16            96             3824           2126        367104       0
    17           160             5428           1151        868480       0
    18           192              351            993         67392       0
    19           320             1343            332        429760       0
    20           384               26            415          9984       0
    21           448               10             26          4480       0
    22           576               47             37         27072       0
    23           640               28            116         17920       0
    24           704                0             11             0       0
    25           768               16            294         12288       0
    26           896              230            175        206080       0
    27          1152              214            178        246528       0
    28          1344               26             22         34944       0
    29          1600               88             97        140800       0
    30          2688              106             53        284928       0
    31         12288               19             33        233472       0

Total memory being used from buckets = 11758016 bytes
Total free memory in buckets = 4622368 bytes
```

```
Memory usage by type: Type and Number of bytes being used

MBUF        = 51200    MCLUSTER    = 587776    SOCKET      = 83328
PCB         = 77312    ROUTETBL    = 1856      IFADDR      = 2176
SONAME      = 5376     MBLK        = 22016     MBLKDATA    = 128192
STRHEAD     = 5632     STRQUEUE    = 15872     STRMODSW    = 2688
STRSYNCQ    = 4384     STREAMS     = 2240      NFS REQ     = 9792
FILE        = 28608    DEVBUF      = 738496    PATHNAME    = 544
KERNEL TBL  = 80816    ADVFS       = 1396032   IPM ADDR    = 256
IFM ADDR    = 832      VNODE       = 2169632   DMASG       = 4342240
SIGQ        = 64       ATM         = 79936     KALLOC      = 909568
TEMP        = 415344   PMAP        = 505504    CRED        = 35584
TASK        = 266112   THREAD      = 198912    AIO         = 2688
SELQ        = 39040    RTTIME      = 640       SVIPC       = 832
FILEBUF     = 12288    MOUNT       = 4352      NAMEI       = 2048
MIPC        = 194624   VMOBJ       = 745984    VMANON      = 689648
VMSEG       = 16064    VMMAP       = 19968     VMENTRY     = 171552
FLOCK       = 768      FIFO        = 31488     ANON        = 624672
VMVPAGE     = 73664    NCALLOUT    = 20416     WS          = 16384
HWINTR      = 34816    SIGACT      = 19456     THREADLOCK  = 13696
DLI         = 17472    VMSWAP      = 16640     IORSRC      = 16384
USB         = 17696
lmccsimu@lmcc1{56}/lungmen/lmccsimu/conf>
lmccsimu@lmcc1{56}/lungmen/lmccsimu/conf>vmstat -P

Total Physical Memory =  1024.00 M
                      =   131072 pages


Physical Memory Clusters:

 start_pfn      end_pfn         type  size_pages / size_bytes
         0          256          pal         256 /    2.00M
       256       130987           os      130731 / 1021.34M
    130987       131072          pal          85 /  680.00k

Physical Memory Use:

 start_pfn      end_pfn         type  size_pages / size_bytes
       256          280    unixtable          24 /  192.00k
       280          284     scavenge           4 /   32.00k
       284          859         text         575 /    4.49M
       859          987         data         128 /    1.00M
```

```
       987        1153          bss          166 /    1.30M
      1153        1318       kdebug          165 /    1.29M
      1318        1322      cfgmgmt            4 /   32.00k
      1322        1323        locks            1 /    8.00k
      1323        1474    unixtable          151 /    1.18M
      1474        1487         pmap           13 /  104.00k
      1487        3544     vmtables         2057 /   16.07M
      3544      130987      managed       127443 /  995.65M
                                      ============================
          Total Physical Memory Use:       130731 / 1021.34M

Managed Pages Break Down:

        free pages = 36302
      active pages = 20172
    inactive pages = 11685
       wired pages = 33714
         ubc pages = 25578
                   ==========
             Total = 127451


WIRED Pages Break Down:

     vm wired pages = 12721
    ubc wired pages = 13808
    meta data pages = 3921
       malloc pages = 1889
       contig pages = 296
      user ptepages = 1010
    kernel ptepages = 57
      free ptepages = 8
                    ==========
              Total = 33710
lmccsimu@lmcc1{57}/lungmen/lmccsimu/conf>lmccsimu@lmcc1{57}/lungmen/lmccsimu/
conf>vmstat -s
Virtual Memory Statistics: (pagesize = 8192)
     20172   active pages
     11685   inactive pages
     37670   free pages
     33712   wired pages
   7167784   virtual memory page faults
   1206709   copy-on-write page faults
   2039711   zero fill page faults
```

```
      495   reattaches from reclaim list
  1564002   pages paged in
       30   pages paged out
1786246454  task and thread context switches
 257197128  device interrupts
5546177823  system calls
```

```
lmccsimu@lmcc1{58}/lungmen/lmccsimu/conf>root@lmcc1{19}/var/admin>swapon -s
Swap partition /dev/rz0b:
    Allocated space:        37500 pages (292MB)
    In-use space:              93 pages (  0%)

    Free space:             37407 pages ( 99%)

Swap partition /dev/rz1e:
    Allocated space:        62500 pages (488MB)
    In-use space:              94 pages (  0%)
    Free space:             62406 pages ( 99%)


Total swap allocation:
    Allocated space:       100000 pages (781MB)
    In-use space:             187 pages (  0%)
    Available space:        99813 pages ( 99%)
root@lmcc1{20}/var/admin>
```

```
root@lmcc1{14}/var/admin>rsh lmpdm df
Filesystem                512-blocks        Used   Available Capacity
Mounted on
root_domain#root              400000      133582      251824    35%    /
/proc                              0           0           0   100%
/proc
var_domain#var                600000      248290      330096    43%
/var
usr_domain#usr               2580080     1213138     1286576    49%
/usr
```

```
rz9f_dmn#rz9f_fs                    2000000      756920     1215088    39%
/usr/local
rz12a_dmn#lungmen                  23773520    12679250    10695200    55%
/lungmen
rz8d_dmn#db                         6000000     5257978      724384    88%
/lungmen/intgr/db
rz8b_dmn#home                       4000000     2520212     1450528    64%
/home
rz10g_dmn#rz10g_fs                 17585920     7533114     9959696    44%
/usr/apc
rz10h_dmn#rz10h_fs                 17585920     2985588    14523232    18%
/lungmen/lmccsimu
/lungmen/lmccsimu@lmcc1             4000000     2495578     1492176    63%
/lmcc1/lungmen/lmccsimu
/lungmen/lmccsimu/data@lmcc1        7760780     2826986     4157716    41%
/lmcc1/lungmen/lmccsimu/data
root@lmcc1{15}/var/admin>

root@lmcc1{15}/var/admin>rsh lmpdm disklabel -r rz8 |tail -10
8 partitions:
#          size     offset    fstype   [fsize bsize   cpg]      # NOTE: values
not exact
  a:     1000000          0      swap                           # (Cyl.    0 -
297*)
  b:     4000000    1000000     AdvFS                           # (Cyl.
297*- 1488*)
  c:    17773524          0    unused        0     0            # (Cyl.    0 -
5289*)
  d:     6000000    5000000     AdvFS                           # (Cyl. 1488*-
3273*)
  e:     4000000   11000000     AdvFS                           # (Cyl. 3273*-
4464*)
  f:     1000000   15000000    unused        0     0            # (Cyl. 4464*-
4761*)
  g:     1773524   16000000    unused        0     0            # (Cyl. 4761*-
5289*)
  h:           0          0    unused        0     0            # (Cyl.    0 -
-1)
root@lmcc1{16}/var/admin>rsh lmpdm disklabel -r rz9 | tail -10
8 partitions:
#          size     offset    fstype   [fsize bsize   cpg]      # NOTE: values
not exact
  a:      400000          0     AdvFS                           # (Cyl.    0 -
176*)
```

```
  b:      800000      400000       swap                          # (Cyl.
176*- 530*)
  c:     8380080           0     unused        0     0            # (Cyl.     0 -
3707)
  d:      600000     1200000      AdvFS                          # (Cyl.
530*- 796*)
  e:     2000000     1800000      AdvFS                          # (Cyl.
796*- 1681*)
  f:     2000000     3800000      AdvFS                          # (Cyl. 1681*-
2566*)
  g:     2580080     5800000      AdvFS                          # (Cyl. 2566*-
3707)
  h:           0           0     unused        0     0            # (Cyl.     0 -
-1)
root@lmcc1{17}/var/admin>
root@lmcc1{17}/var/admin>rsh lmpdm disklabel -r rz12 | tail -10
8 partitions:
#          size     offset    fstype   [fsize bsize   cpg]      # NOTE: values
not exact
  a:    17773524           0     AdvFS                          # (Cyl.     0 -
5289*)
  b:           0           0     unused        0     0            # (Cyl.     0 -
-1)
  c:    17773524           0     unused        0     0            # (Cyl.     0 -
5289*)
  d:           0           0     unused        0     0            # (Cyl.     0 -
-1)
  e:           0           0     unused        0     0            # (Cyl.     0 -
-1)
  f:           0           0     unused        0     0            # (Cyl.     0 -
-1)
  g:           0           0     unused        0     0            # (Cyl.     0 -
-1)
  h:           0           0     unused        0     0            # (Cyl.     0 -
-1)
root@lmcc1{18}/var/admin>


root@lmcc1{24}/var/admin>swapon -s
Swap partition /dev/rz0b:
    Allocated space:        37500 pages (292MB)
    In-use space:              93 pages (  0%)
    Free space:             37407 pages ( 99%)
```

```
Swap partition /dev/rz1e:
    Allocated space:        62500 pages (488MB)
    In-use space:              94 pages (  0%)
    Free space:             62406 pages ( 99%)


Total swap allocation:
    Allocated space:       100000 pages (781MB)
    In-use space:             187 pages (  0%)
    Available space:        99813 pages ( 99%)
root@lmcc1{25}/var/admin>rsh lmis swapon -s
Swap partition /dev/rz16b (default swap):
    Allocated space:        31250 pages (244MB)
    In-use space:            1316 pages (  4%)
    Free space:             29934 pages ( 95%)

Swap partition /dev/rz18b:
    Allocated space:        62500 pages (488MB)
    In-use space:            1327 pages (  2%)
    Free space:             61173 pages ( 97%)


Total swap allocation:
    Allocated space:        93750 pages (732MB)
    Reserved space:         21782 pages ( 23%)
    In-use space:            2643 pages (  2%)
    Available space:        71968 pages ( 76%)
root@lmcc1{26}/var/admin>


root@lmcc1{25}/var/admin>rsh lmis swapon -s
Swap partition /dev/rz16b (default swap):
    Allocated space:        31250 pages (244MB)
    In-use space:            1316 pages (  4%)
    Free space:             29934 pages ( 95%)

Swap partition /dev/rz18b:
    Allocated space:        62500 pages (488MB)
    In-use space:            1327 pages (  2%)
    Free space:             61173 pages ( 97%)


Total swap allocation:
    Allocated space:        93750 pages (732MB)
```

```
    Reserved space:          21782 pages ( 23%)
    In-use space:             2643 pages (  2%)
    Available space:         71968 pages ( 76%)
root@lmcc1{26}/var/admin>rsh lmpdm swapon -s
Swap partition /dev/rz9b (default swap):
    Allocated space:         50000 pages (390MB)
    In-use space:             4317 pages (  8%)
    Free space:              45683 pages ( 91%)

Swap partition /dev/rz8a:
    Allocated space:         62500 pages (488MB)
    In-use space:             4429 pages (  7%)
    Free space:              58071 pages ( 92%)


Total swap allocation:
    Allocated space:        112500 pages (878MB)
    Reserved space:          41473 pages ( 36%)
    In-use space:             8746 pages (  7%)
    Available space:         71027 pages ( 63%)
root@lmcc1{27}/var/admin>
```

1

XI. 每日工作前檢測項目 Daily Operational Readiness Test (DORT)

- **Verify simulator running (if not, start simulator as described in Attachment A)**

- **Check Task Handler on the simulation computer (LMCC1)**

  Login on LMCC1as user: .....
  Password: .....

  After completing the startup on the instructor station, the following tasks should run on the simulation host – LMCC1 (see also the file ~conf/.tasks, where the processes are listed):

Tskhdl	-	Task handler (runs from the beginning.
cs_ais	-	Communication server (runs from the beginning).
sctlcp	-	Cyclic Control task
sctlap	-	Non-cyclic Control task
adersrv	-	Asynchronous Data Exchange Server
adesclnt	-	Asynchronous Data Supply Client
sdesrv	-	Synchronous Data Exchange Server
modela/b/c	-	Model task A/B/C/D
lu_server	-	Server for Foxboro

  If the tasks tskhdl, cs_ais or sctlcp are missing, the simulator won't run at all; if one or more of the other tasks are missing, certain simulator functions may fail.

  You may also use the test monitor to check for tasks, which are not running. For this purpose start the test monitor from the UNIX prompt by the command : **sems&**

  - Use the function "Edit task table" to see, which processes should run within the simulator (do not edit them, if you do not exactly know what to do).

  - With "Task Control" you are able to see, which processes are actually running ("Stop Task" toggle button on) or which processes have failed ("Start Task" toggle button on).

  - You may stop and start tasks with the test monitor (except cs_ais!!), ones the simulator is running.

  If a task is missing, check the error files for the cause and solve it, if possible. For details refer to OMM - Section 3/1.1 "Simulator Troubleshooting".

➢ **Check the panel devices using the panel Test Program at the Instructor Station**

The test of the simulators Panel I/O-System is done using the foreseen I/O equipment and final panel configuration. The configuration data contain all information about the panel tiles with their dedicated DI's, DO's and /or AO's as well as the wiring information from the individual button/switch, lamp or meter to the connector module which is the HW interface to the I/O-System. In order to demonstrate the evidence that the I/O-system host-software is working properly with the I/O-System hardware the test shall be made as follows applying the Panel Test Program:

DI-Test

Select key "1".

To stop DI-test hit "CTRL C".

If any key or switch on the panel is moved following information from the latest changed DI is shown on the screen:

- panloc, global offset number, title, distributor, plug, pin, channel, element type, nearest lamp (ON/OFF) and description.

The nearest lamp will be on during button is pressed.

DO - Test per Section

Select key "5" (first time wait for getting all DO's sorted by panel location from CMS database).

The test starts now with setting the complete panel lamps to on. The screen shows the first found panel section in the database. While entering the wanted panel section only the lamps belonging to the entered signs turned on.

Following keys are now allowed to hit:

CR - start a new panel section
- exit DO-Test

AO-Test Section

Select key "9" (first time wait for getting all AO's and DO's sorted by panel location from CMS database).

The test starts now with setting the hole panel AO-Meters of their scale (default). The screen shows the first found panel section in the database. While entering the wanted panel section only the meters belonging to the entered signs show the value.

Following keys are now allowed to hit:

CR - start a new panel section
- exit AO-Test

XII. 模擬器系統維修策略與方法

一個成功的維修策略需要有完整的規劃， 資訊收集是第一個邏輯步驟，善加利用系統服務紀錄簿及詢問使用者和觀察現象等都是重點：

- 第一個出現的警訊或錯誤是甚麼？
- 最近有無更改設定或安裝任何軟體、韌體？
- 出現那些現象或異音(聲音)？
- 使用者是否曾經做過初步的檢修？是甚麼動作？結果是甚麼？
- 問題是出在作業系統嗎？ 如果不是，則執行自我診斷測試(power on self test, POST)； 如果是，則收集系統資訊如利用 error log, operator log, crash dump 等檔案，瞭解問題所在，或執行 OS-based 的診斷程式如 DEC VET。
- 將問題簡單化，一次只解決一個問題，每次只更動一個變化。
- 檢視所有可能的設備、零件的指示燈是否正常？檢查信號線/電源線的連接接頭是否鬆動、斷路？
- 確認所有驅動程式都正常？
- 重新啓動(rebooting system)，並注意 error message， 判斷是硬體、還是軟體的問題？
- 當模擬器正在 running 時，檢查下列 task 是否正常：
  - sctlcp
  - sctlap
  - cs_ais
  - modela
  - modelb
  - modelc
  - modeld
  - lu_server
  - pra_lugm
  - snd_server

- 當模擬器正在 running 時，並 downloading the simulator 時檢查下列 log files：

  lmccsimu @LMCC1 ($HOME)
  - error.log
  - lmccsimu_<date&time>_sim.log
  - cs_ais.log

- ✧ modela.log
- ✧ modelb.log
- ✧ modelc.log
- ✧ modeld.log
- ✧ pra_lungmen.log
- ✧ rpcde.log
- ✧ sctlap.log
- ✧ sctlcp.log
- ✧ sound.log
- ✧ tesmon_crash

lmsimu @lmis (/usr/apc/lmsimu/errorlog)

- ✧ ais_error.log
- ✧ last_errormsg
- ✧ simcom_error_status
- ✧ ais_error_status
- ✧ simcom_error.log

➢ **當系統出現問題時的檢查準則**

✧是否所有系統都在 running　(使用 login, telnet 檢查)
✧是否所有 NFS 設置均可用　(使用 df, mount 檢查)
✧是否所有 tools/licences (SEMS/EMPRESS/DATAVIEWS) 均可用 (使用 tesmon / dbmgr　檢查)
✧資料庫 database 是否可用 (使用 db_clean 檢查)
✧CEP (central error processor) running (使用 ps –e | grep cep 檢查)
✧是否所有 simulation processes running (使用 ps –Ulmsimu 檢查)
✧是否所網路連結正常 running (使用 ping 檢查)
✧檢查磁碟空間是否夠用　(使用 df 檢查)
✧使用者可以有正常/正確的進出系統　(使用 ls –l / chown chmod 檢查)
✧taskhandler interface 正常運作　(使用 thmon 檢查)
✧shared memory 正常運作　(使用 glbmon 檢查)
✧檢查 simulator logfiles (使用 more, tail, cat 檢查)
✧如果更動設備的 IP address ，則於更改後必須再執行 Impress updatekey，否則資料庫將無法動作。

➢ 假如資料庫無法正常啓動，可用下列方法解決被鎖定的問題：

1.用您自己的 user ID 和對應的資料庫清除所有被鎖住的資料庫：

db_clean -v /lungmen/lmccsimu/db/sdb/org.db

2. 用 user empress 和對應的資料庫清除所有被鎖住的資料庫：

db_clean -v /lungmen/lmccsimu/db/sdb/org.db

3. 檢查資料庫的鎖住狀況：

empadm /lungmen/lmccsimu/db/sdb/mm.db lockinfo

4. 如果仍然無法讀寫資料庫，則清除/停止所有使用者使用之資料庫：

empadm /lungmen/lmccsimu/db/sdb/mm.db lockclear

empadm /lungmen/lmccsimu/db/sdb/mm.db coordclear

如果要清除所有被鎖住的資料庫可用 db_clearlocks (user: empress)

5. 如果前述方法均無效，則用下述方法刪除對應之 lock-files.

rm /lungmen/lmccsimu/db/sdb/mm.db /_lock/*.lck

➢ 避免累積無效之鎖住資料庫可用下列方法行之：

1: 經常執行 db_clean 程序

login as user empress and create crobtab-entry by using the command *crontab -e*

0 5 * * 0-5 env MSPATH=/usr/local/empress/v6.6 /usr/local/sems/bin/db_clean /lungmen/lmccsimu/db/sdb >> /var/tmp/empclean.log 2>&1

save the file and check for correct entry using *crontab -l*

create Logfile using *touch /var/tmp/empclean.log*

2：啓動模擬程式前執行 db_clean 程序

edit the file *.login* of user malsimu and enter the following command line into a right position

db_clean -v /lungmen/lmccsimu/db/sdb

➢ 如果模擬器運作有問題，確認已按正確程序 upload simulator，觸發 LMCC1，啓動 tskhdl 和 cs_ais processes ，請再檢查 LMCC1 上的相關檔案內容：

tskhdl - Task handler (runs from the beginning.
cs_ais - Communication server (runs from the beginning).
sctlcp - Cyclic Control task
sctlap - Non-cyclic Control task
adersrv - Asynchronous Data Exchange Server
adesclnt - Asynchronous Data Supply Client
sdesrv - Synchronous Data Exchange Server
lu_server - Server for Foxboro
modela - Model A
modelb - Model B
modelc - Model C
modeld - Model D
snd_server - Sound Task
(pra_lugm - temporary PRA Task fore usage with WINNT PRA Client)
/lungmen/lmsimu/conf/.sim_conf Simulator configuration file
/lungmen/lmsimu/conf/.tasks Simulator tasks to be started
/lungmen/lmsimu/data/IC/I_CONST.icn IC for all constants
/lungmen/lmsimu/db/sdb Simulator data base

- CEP(central error process) 掌管錯誤訊息和警告，提供診斷資料，其包含下列特徵及工作：
  - ✧ 收集來自模擬系統的 process 資料。
  - ✧ 附加詳細說明 error messages 的資料，以加強判讀。
  - ✧ 集中保持一所有錯誤訊息於同一檔案。
  - ✧ 當模擬系統產生一錯誤訊息時可收集到一個 log 檔。
  - ✧ 可將錯誤訊息資料存到預先定義好的目的地。

- 每日系統維護工作(檢查清單)：
  - ✓ check mail for user "root".
  - ✓ check motd-files (**m**essage **o**f **t**he **d**ay) on /etc
  - ✓ check of the Event-Log-File: "uerf -R | more".
  - ✓ check latest information in the files /var/adm/messages: "tail -200 messages | more".
  - ✓ check latest information of the files /var/adm/sialog: "tail -200 sialog| more".
  - ✓ check recent "logins": "last | more".

- ✓ check which users are (still) logged in, how long they are logged in: "f" or "who -a".
- ✓ check all processes running on the System:
  "ps -ef | more".
  All running processes still active ?
  Are there some processes not needed any more ?
- ✓ check used "message queues", "shared segments" und "semaphores": "ipcs".
  delete a.m. "inter-process-communication-tools" not used anymore: ipcrm -s id; ipcrm -q id; ipcrm -m id.
  "glbmon -a -d"
- ✓ delete all *.i-files generated by the SEMS-Tools (usually automatic done by "cron"; results via mail to user "root")
- ✓ check whether "core-dumps" have been generated:
  "find / -name core -print"; "file <core-dump-file>".
  delete core-dump-file if not needed (usually automatic done by "cron"; results via mail to user "root").
- ✓ check available disc-space: "df".
- ✓ check last-day-information under "/var/adm/syslog.dated":
  (auth.log; daemon.log; kern.log; lpr.log; mail.log; syslog.log; user.log)
- ✓ check existing mail-messages on the system under /var/spool/mail. Inform the user about mail not yet picked up and deleted/saved.

➢ 每月系統維護工作(檢查清單)

- ✓ check motd-file (**m**essage **o**f **t**he **d**ay) on /etc
- ✓ make a printout of the Event-Log-File:
  "uerf -R -o ful > uerf.log"
  "lpr -P<printername> uerf.log"
  change directory to /var/adm
  list owner, group aund access-rights of "binary.errlog"
  delete /var/adm/binary.errlog
  touch /var/adm/binary.errlog
  adjust owner, group and access-rights if necessary
- ✓ make a printout of the file /var/adm/messages
  change directory to /var/adm
  list owner, group and access-rights of "messages"

delete messages

touch messages

adjust owner, group and acces-rights if necessary

- ✓ make a printout of the file /var/adm/sialog

change directory to /var/adm

list owner, group and access-rights of "sialog"

delete sialog

touch sialog

adjust owner, group and access-rights if necessary

- ✓ make a printout of all recent "logins":

"last > filename".

"last" displays information about previous logins.

"/var/adm/utmp" contains information about who is currently using the system.

"/var/adm/wtmp" record of all logins and all logouts

"var/adm/lastlog" contains last login-times. Used e.g. by "finger".

list owner, group and access-rights of the a.m. files

delete a.m. files

touch a.m. files

adjust owner, group and access-rights if necessary

/var/adm/smlogs:contains information about the installation and the upgrade of the operating system.

- ✓ /var/adm/syslog: contains for every day certain Control System Log-files. The information are generated by syslogd-daemon. Old files get erased frequently via "cron".
- ✓ check if system configurator is still up to date, update configuration printout recommended
- ✓ run system backups

肆、建議事項

A. 訓練有關之建議事項

一、 參與工作訓練，對一些基礎課程可在國內先修以提早進入情況，建議先安排在國內上基礎課程，再來受訓，則可收事半功倍之效果。

二、 參與設計、組裝測試工作(On job training) 是爲對將來維護工作最有用之時機，因爲在此階段，學員可了解設計者的工作歷程及除錯改善之方法。對將來運轉維護工作有實質的幫助。

三、 建立測試用實驗室，例如建立 Foxboro I/A 設備教具，充實訓練教材，以培訓維修人員。

四、 國外訓練教材，最好能在電廠資料室或相關課室留存一份，供將來培訓相關工作之工程師參考。

B. 與模擬器驗收有關之建議事項

一、 由於模擬器設計分別由 STN、GE、Foxboro 三大家設計，再加上使用設計圖面版本的差異，因此其間的資料(database)有許多對不上(相對應)的地方，預期在 GE 做安裝整合測試時會有一些麻煩，建議將來要做 FAT/SAT 時，參加人員務必仔細測試各個點的資料、各項功能及系統反應時間。

二、 部份 Mimic 上之 Light Tiles 模組爲針對核能四廠特別定製，內部使用扁平式 LED，如更換時，需整個模組更換，無法只更換 LED。備品需多加考量。

三、 參與驗收人員應注意點收所有硬軟體的媒體及文件，尤其要注意(新)版本，license，數量，是否有給足？設計用之工具軟體是否給予正確的版本？文件是否足夠？

四、 不同廠家之 Cable marker、wire marker 編法不同。大部份 Mimic 上之 Light Tile 及 Alarm/Annunciator 上之燈號 Windows，配線均超過 2 條 wires，但 wire 上之 marker 確相同，不易識別。將來將視需要給予適當，以利維修工作。