SCOPE OF SPECIFICATIONS

1. TECHNICAL SPECIFICATIONS
2. CIVIL WORK

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TOR OF DME SYSTEM FOR SUPPORTING PBN OPERATION (DME RNAV)

SECTION 1

TECHNICAL SPECIFICATIONS

1. Definitions

In the specification, the following words and expression shall have the meanings assigned to them here under except where the context otherwise requires :

AEROTHAI	Aeronautical Radio of Thailand Ltd.
Essential requirement specification [E]	Essential requirement specification which is mandatory requirement by which the tenderer shall fully comply with AEROTHAI's requirement stipulated in Scope of Specifications. The Proposal will be rejected if the proposed system, functions of features fail to comply with Essential requirement specification.
Proposal	The response to the requirement specified in Scope of Specifications.
Tenderer	The juristic person, firm or company who offers to provide materials or perform a service or do a job with AEROTHAI at a specified cost or rate.
Contractor	The juristic person, firm or company whose tender(s) /proposal(s) has /have been accepted by AEROTHAI and who agrees to accomplish the activities for AEROTHAI.
ICAO Annex 10 Vol. I	Aeronautical Telecommunications : Volume I Radio Navigation Aids. Sixth Edition, July 2006, Amendments 89
ICAO Doc 8071 Vol. I	Manual on Testing of Radio Navigation Aids: Volume I Testing of Ground-Based Radio Navigation Systems. Fourth Edition – 2000, Amendments 1
ICAO Annex 14 Vol. I	Aerodromes : Volume I Aerodrome Design and Operations. Sixth Edition, July 2013, Amendments 11-B
ICAO Doc 9157	Aerodrome Design Manual Part 6: Frangibility, First Edition – 2006

2. General Requirements [E]

2.1	Three (3) DME (Distance Measuring Equipment) systems shall be newly installed at PRACHINBURI, SUKHOTHAI and TAK as specified in APPENDIX A.		
2.2	Each DME system shall be consisted of the following :		
	2.2.1	Power supply system, as specified in [2.4] and [4]	
	2.2.2	Dual DME/N (Narrow Spectrum Characteristics) equipment (dual transmitter and dual monitor) that be capable of transmitting power about 1000 watts – the so called “high-powered” DME system. All RF generators shall be synthesizers. Additionally, the status output of DME equipment should be capable of supporting all type of the following, (see also Fig.8-1, 8-2, and 8-3)	
		2.2.2.1	Ethernet for RMM /RCSU
		2.2.2.2	RS-232 for RCSU (Only if DME equipment cannot provide RMM /RCSU Ethernet output)
		2.2.2.3	RS-232 for RMM (Only if DME equipment cannot provide RMM /RCSU Ethernet output)
	2.2.3	Antenna system for the DME/N equipment, as specified in [3.3].	
	2.2.4	AC/DC power line, transmission lines, control lines, test cables and all relevant accessories, as specified in [2.5].	
	2.2.5	LCSU of DME (typically embedded in the DME equipment) and its local computer at DME station, as specified in [5.1].	
	2.2.6	RCSU of DME at the technical control room of ATC tower, as specified in [5.2].	
	2.2.7	RMM (computer) of DME at the technical control room of ATC tower, as specified in [5.4].	
	2.2.8	RSU of DME at ATC control room of ATC tower, as specified in [5.3].	
	2.2.9	Lightning protection, surge protection and grounding system, as specified in [2.6]	
2.3	The DME system shall /should be complied with the following		
	2.3.1	The system performance and its signal-in-space quality shall be at least complied with the ICAO Annex 10 Vol. I	

	2.3.2	The equipment shall be designed for high-reliability operation. Each tenderer shall submit reliable analysis of the reliability, such as MTBF, MTBO and MTTR in the proposal.	
	2.3.3	The dual independent transmitters shall be operated as main and standby facilities. Maintenance on any equipment should be accomplished without disruption the operation of the other	
	2.3.4	The equipment should be the modular design, or an easy plug-in card / modules for easy maintenance purpose.	
	2.3.5	Indoor equipment shall be designed for continuous operation at least under the ambient temperature range of 0 °C to +50 °C with a relative humidity of up to 95% Outdoor equipment shall be designed for continuous operation at least under the temperature range of -40 °C to +60 °C with a relative humidity of up to 100%, up to 100 mph (160 Km/h) wind velocity, and up to ½" (1.3 cm) accumulation of clear ice on all outdoor components. All outdoor materials shall be suitably weather protected by appropriate to high grade coat / paint in order to withstand severe ambient conditions of outdoor installation due to temperature, humidity, rainfalls, as specified in ICAO Annex 14, Vol. I.	
2.4	Details about power supply		
	2.4.1	Single phase AC power system with 220 ± 10 VAC, 50 Hz ± 5%. shall be provided to all DME and peripheral equipment.	
	2.4.2	The UPS & STS system for each DME system shall be provided and installed at each site (see Fig. 4-1) The full system is composed of the following :	
		2.4.2.1	UPS two (2) sets and their associated BACKUP batteries (may be internal or external battery system). This maintenance-free battery system shall be capable of operation at least 30 minutes in the event of an AC main failure. The specification of UPS system is specified in [4.1]
		2.4.2.2	STS two (2) sets. The specification of STS system is specified in [4.2]

		2.4.2.3	All monitoring and control equipment for UPS & STS system is specified in [5.1], [5.2], [5.3], and [5.4].
	2.4.3	BACKUP battery (with charger unit) for DME equipment shall also be included in the power supply system. Note that, this equipment is <u>not</u> the same part as BACKUP battery used for supporting the UPS system [2.4.2.1].	
2.5	Details about AC/DC power lines, transmission lines, control lines, test cables and all relevant accessories.		
	2.5.1	All AC/DC power lines, transmission lines, control lines and relevant accessories (e.g. connectors, cable trays, conduits and cable ties) shall be provided by the contractor. If the installation work involved with the buried cables. Those shall be *"underground-type"* and fitted in HDPE or RSC pipes which the inner diameter shall be wide enough for fitting all cables easily.	
	2.5.2	All transmission lines shall be laid in a different pipe separated from that of AC power lines.	
	2.5.3	If provided, The underground cable work shall be done by the contractor. The trench for lying underground cable shall be dug more than 50 cm in depth from ground surface and <u>not</u> less than 30 cm in width. The trench basement shall be covered with 20 cm thick of sand which is the base of underground cable. Finally, the underground cable shall be covered with 20 cm thick of sand topping with 20 cm thick of soil.	
	2.5.4	All known power and control lines (or else cable routes) leading to the facility shall be marked out by the contractor.	
	2.5.5	All relevant accessories necessary for initial set up, maintenance, or else system calibration (<u>BOTH</u> transmitter <u>AND</u> monitor calibration) shall be provided, as specified in [10.3]	
2.6	Details about lightning protection, surge protection and grounding system.		
	2.6.1	All above system must be complied with IEC-62305 international standard or equivalent.	

	2.6.2	The tenderer shall provide or detail the interconnection diagram of complete protection system in the proposal (including brand, and model of the equipment).	
	2.6.3	The lightning protection system shall adequately protect all of the DME and peripheral equipment in the event of a lightning strike.	
	2.6.4	The surge protection system shall be provided to all POWER and TELECOM line. Each unit of arrestor shall also be embedded with an indicator lamp to alarm when damage / failure occur. The specification of POWER surge protection shall be at least as following :	
		2.6.4.1	Maximum Continuous Operating Voltage (Uc) at least 320 VAC
		2.6.4.2	Voltage Protection Level (Up) less than 1.5 KV
		2.6.4.3	Maximum Discharge Current (Imax) (8/20 μs) at least 100 KA
	2.6.5	The grounding system shall provide the total resistance not exceed 5 Ω.	

3. Specifications of DME/N [E]

3.1	**Transponder characteristics**		
	3.1.1	The system shall operate with vertical polarization in the frequency band of 960 MHz to 1215 MHz. The interrogation and reply frequencies shall be paired [ANNEX10 / Vol. I – Table A / p.3-100], with 1 MHz spacing between channels.	
	3.1.2	The operating channels of all three (3) DME systems, PRACHINBURI (110X), SUKHOTHAI (100X) and TAK (47X) are specified in APPENDIX A.	
	3.1.3	The operating frequency of each interrogation and reply signal shall not vary more than ± 0.002 % from the assigned frequency [ANNEX 10 / Vol. I / Paragraph 3.5.4.1.2, and 3.5.4.2.2]. Frequency setting shall be adjusted by means of software.	
	3.1.4	The power amplifier of the transponder shall be capable of providing full peak output power of not less than 1000 watts to the antenna.	
	3.1.5	Interrogation pulse pairs with correct spacing and nominal frequency shall trigger the transponder if the peak power density at THE TRANSPONDER ANTENNA is at least -103 ± 1 dBW/m2 and this value cause the transponder to reply with an efficiency of at least 70% [ANNEX 10 / Vol. I / Paragraph 3.5.4.2.3.1, 3.5.4.2.3.2, 3.5.4.2.3.5 and 3.5.5.3.2.1]	
	3.1.6	Bandwidth and selectivity shall meet the requirements specified in [ANNEX 10 / Vol. I / Paragraph 3.5.4.2.6] such that for each deviated interrogation frequency :	
		3.1.6.1	The received signal, $f \pm 100$ KHz from the center frequency, should be suppressed not more than 3 dB.
		3.1.6.2	The received signal, $f \pm 900$ KHz from the center frequency, should be suppressed more than 80 dB.
		3.1.6.3	Any spurious signal from other DME channel, should be suppressed more than 75 dB.
	3.1.7	DME/N-Decoder Rejection. An interrogation pulse pair with a spacing of ± 2 μs, or more from the nominal value, shall be rejected [ANNEX 10 / Vol. I / Paragraph 3.5.4.3.3].	

	3.1.8	Pulse shape and spectrum of pulse modulated signal shall meet the requirements of [ANNEX 10 / Vol. I / Paragraph 3.5.4.1.3 and 3.5.5.1.3].	
		3.1.8.1	Pulse rise time (between 10 to 90% of the leading edge) $\leq 3\ \mu s$
		3.1.8.2	Pulse decay time (between 10 to 90% of trailing edge) $\approx 2.5\ \mu s$, and $\leq 3.5\ \mu s$
		3.1.8.3	Pulse duration (between 50% of the leading, and trailing edges) $\leq (3.5 \pm 0.5)\ \mu s$
		3.1.8.4	The instantaneous amplitude of the pulse does <u>not</u>, at any instant between the point on the leading edge which is 95% of the maximum amplitude and the point on the trailing edge which is 95% of the maximum amplitude, fall below a value which is 95% of the maximum amplitude of the pulse.
	3.1.9	Pulse pair spacing shall be $(12.0 \pm 0.1)\ \mu s$ or else should be $(12.0 \pm 0.25)\ \mu s$ [ANNEX 10 / Vol. I / Paragraph 3.5.4.1.4].	
	3.1.10	System time reference shall be configurable between 1st or 2nd pulse timing (1st pulse default)	
	3.1.11	Reply delay, between 50% amplitude of the 1st (or 2nd) leading edge of the interrogation <u>and</u> reply pulses should be typically $50\ \mu s$ for X-channel, and adjustable at least between 35 to 50 μs [ANNEX 10 / Vol. I / Paragraph 3.5.4.4.1 and 3.5.4.4.3].	
	3.1.12	Pulse width, pulse pair spacing and reply delay shall be adjustable by means of software to the specified values <u>without</u> removing any module from the assembly.	
	3.1.13	Dead time and CW & echo suppression should be adequately adjustable for each DME station installed [ANNEX 10 / Vol. I / Paragraph 3.5.4.2.9].	
		3.1.13.1	Short distance echo suppression (for echo pulses that occur between the pulses of a valid interrogation pair) should mitigate the reply timing error by more than $0.15\ \mu s$, by assistance of AGC reduction technique.
		3.1.13.2	Dead time (measured from the DECODER output which in line with the 2nd interrogation pulse) should be adjustable between 50 to 150 μs , or better (nominal 60 μs).

		3.1.13.3	Long distance echo suppression (for echo pulses that fall after the dead time 60 μs interval) if enabled, should be. adjustable by both the assistance of AGC reduction technique (e.g. 0 to -100 dBm) and time gate (measured from DECODER output which in line with the 2nd interrogation pulse) between 60 to 360 μs , or better.
	3.1.14	The transponder shall be capable of continuous operation at a transmission rate (the so-called *"Pulse Repetition Rate"*) between 700 to 4800 pps. Where the nominal rate should be 2,700 ± 90 pps (if 100 aircraft are to be served).	
	3.1.15	Identification shall meet the requirements specified in [ANNEX 10 / Vol. I / Paragraph 3.5.3.6] for both cases of stand-alone and collocated with VOR.	
	3.1.16	The peak power of the constituent pulses of any transponder pulse pair shall not differ by more than one (1) dB. [ANNEX 10 / Vol. I / Paragraph 3.5.4.1.5.4]	
	3.1.17	DME equipment shall provide / embed the coupling port for measuring peak output power without shutdown / turn OFF the equipment.	
	3.1.18	The protected coverage of DME/N shall be determined by using Figure C-20 of [ANNEX 10 / Vol. I / Attachment C / Paragraph 7.2.1]. The propagation loss for paths without obstructions uses the IF-77 propagation model.	

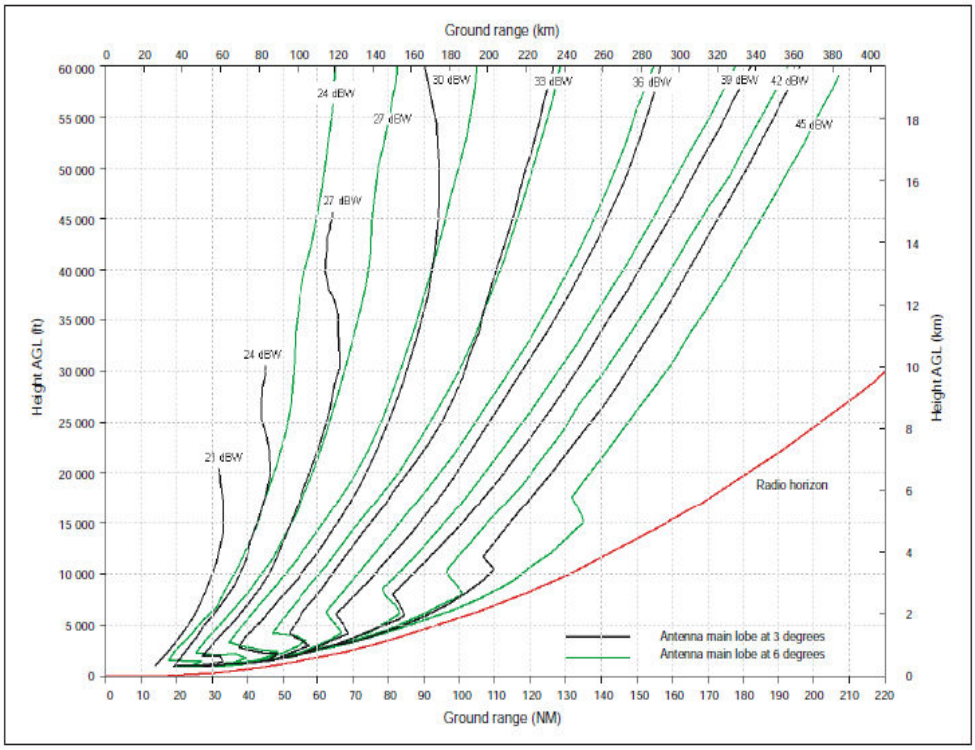


Figure C-20 of [ANNEX 10 / Vol. I / Attachment C / Paragraph 7.2.1]. Necessary EIRP of DME transponder to achieve a power density of -89 dBW/m2 (at airborne receiver) as a function of height above and distance from the DME.

The above figure is based on the following example,

3.1.18.1	Airborne receiver sensitivity	-120 dBW/m2
3.1.18.2	Antenna gain	+9 dBi
3.1.18.3	Antenna height	+5 m (17 ft) AGL over flat terrain.
3.1.18.4	Power density required at antenna	-111 dBW/m2

Remark : Minus 111 dBW/m2 at the antenna corresponds to minus 89 dBW/m2 at mid-band frequency.

3.1.19 The transponder shall not contribute more than $\pm 1\ \mu s$ to the overall system error (relative to accuracy) [ANNEX 10 / Vol. I / Paragraph 3.5.4.5.1].

3.2	Monitor characteristics			
	3.2.1	The monitor system of DME shall serve three (3) purposes.		
		3.2.1.1	To be used as monitoring basic maintenance parameters e.g. power supply voltage, Digital I/O, BITE, BYPASS /changeover mode, antenna VSWR, environmental sensing, version of module/CCA etc.	
		3.2.1.2	To be used as a "Test Signal Generator" in conjunction with a built-in test unit for calibration, testing and maintenance of the transponder.	
			3.2.1.2.1	Be able to generate pulse pair both "in" and "out-of-tolerance" condition, e.g. pulse spacing, pulse width, pulse rise time, pulse decay time.
			3.2.1.2.2	Be able to select /adjust the deviated frequency of simulated interrogation signals, from 0 to 900 KHz.
			3.2.1.2.3	Be able to select /adjust the attenuation range of simulated interrogation signals, from -91 to -20 dBm or better, at the input point of a transponder Remark : minus 91 dBm is equivalent to minus 103 dBW/m2 in a typical installation.
			3.2.1.2.4	Be able to select /adjust the PRF of simulated interrogation signals, from 700 to 4800 pps, or better.
			3.2.1.2.5	Test Signal Generator shall also provide the test points for analyzing /confirming the correctness of the simulated signal by external measuring equipment (e.g. oscilloscope).
		3.2.1.3	To be use as ensuring the transponder signal within the tolerance [ANNEX 10 / Vol. I / Paragraph 3.5.4.7.2]. The monitor system shall initiate an alarm signal if any abnormal condition occurs as following,	
			3.2.1.3.1	Variation of the transponder frequencies beyond the control range of the reference circuits [ANNEX 10 / Vol. I / Paragraph 3.5.4.7.2.4]
			3.2.1.3.2	Spacing error of transmitted pulse pair exceeds ± 0.10 μs [ANNEX 10 / Vol. I / Paragraph 3.5.4.7.2.4]

			3.2.1.3.3	Reply delay error exceeds ± 1.0 μs for DME high power. Reply delay error exceeds ± 0.5 μs for DME low power. [ANNEX 10 / Vol. I / Paragraph 3.5.4.7.2.2].
			3.2.1.3.4	Transmitting pulse count (Pulse Repetition Frequency) falls below 700 pps or above 6,000 ppps.
			3.2.1.3.5	Continuous or loss of identification.
			3.2.1.3.6	A fall of 3 dB or more in transmitted power output [ANNEX 10 / Vol. I / Paragraph 3.5.4.7.2.4], Monitor system should also be able to detect the abnormal VSWR condition.
			3.2.1.3.7	A fall of 6 dB or more in the minimum transponder receiver sensitivity provided that this is <u>not</u> due to the action of the receiver automatic gain reduction circuits. [ANNEX 10 / Vol. I / Paragraph 3.5.4.7.2.4].
		The monitor system shall also identify the faulty module / CCA (e.g. with graphic mode or clear alarm message), and log alarm histories with accurate / no drift of mmddyy & time stamp. The monitor system shall be installed both at the designated LOCAL and REMOTE point [5].		
	3.2.2	The monitors shall be configurable such that both of them are capable of reporting the status of <u>both</u> the operating (on-antenna) <u>and</u> standby (on-dummy) transponder.		
	3.2.3	In case of [3.2.1.3], the monitors shall be configured either in “AND” or “OR” mode for a system changeover /shutdown in the event of failure.		
	3.2.4	In case of [3.2.1.3], monitoring actions shall be complied with the following : The primary alarms generated by [3.2.1.3.2] and [3.2.1.3.3] shall initiate a <u>TRANSFER</u> action when the main transponder is operating (on-antenna), or else a <u>SHUTDOWN</u> action when the standby transponder is operating (on-antenna).		

		The secondary alarm generated by the remaining of [3.2.1.3] shall not affect TRANSFER /SHUTDOWN action, but still display whether the system not working properly.		
	3.2.5	The monitor should persist for a certain period before the monitoring action in order for avoiding interruption, due to transient effects provided by the transponder. This period shall be as low as practicable, but shall not exceed 10 s. [ANNEX 10 / Vol. I / Paragraph 3.5.4.7.2.5].		
3.3	DME antenna system			
	3.3.1	The antenna shall be capable of radiating DME signal throughout the DME frequency band (960 MHz to 1215 MHz) so that changing of the operating frequency needs no readjustment of the antenna.		
	3.3.2	The antenna gain shall not be less than +9 dBi.		
	3.3.3	The antenna radiation pattern shall be submitted in the proposal.		
		3.3.3.1	For the horizontal radiation pattern, the antenna shall be omni-directional type.	
		3.3.3.2	For the vertical radiation pattern, The antenna main lobe shall be maximum at three (3) degrees (see [3.1.18] or Figure C-20 of [ANNEX 10 / Vol. I / Attachment C / Paragraph 7.2.1]).	
	3.3.4	The contractor shall be responsible for the following :		
		3.3.4.1	Propose the drawings of TRIANGULAR steel tower, used as a support for the DME antenna. The drawings detail shall conforming to the followings :	
			3.3.4.1.1	The tower shall be triangular type and self support.
			3.3.4.1.2	The tower shall be made of galvanized steel.
			3.3.4.1.3	The length of each triangular section shall be 60 cm, and the height of the tower shall be at least 9 m.
			3.3.4.1.4	The tower base shall be established with reinforce concrete and able to support the weight of the tower and two (2) climbers.
			3.3.4.1.5	The tower shall be equipped with all relevant protection system [2.6].
		3.3.4.2	Provide the DME tower and all related accessories necessary for installation, e.g. tower adapter plate, conduits, clamps, screws, nuts etc.	

		3.3.4.3	Install the DME tower, the tower foundation and all relevant protection system [3.3.4.1.5].
	3.3.5	Double LED obstruction lighting devices with photo-switch shall be co-installed with the antenna system [Annex 14 / Vol. I / Chapter 6] or Federal Aviation Administration (FAA) (AC150/5345-43F or 43G). Additionally, type and model shall be submitted in the proposal.	

4. Specifications of UPS, STS and Load Centre [E]

The conceptual diagram of how to integrate each power supply subsystem, is depicted in Fig.4-1. The monitoring & control equipment for UPS & STS is described in [5]. The complete "Intersystem Connection and Communication Diagram" is described in [8].

4.1	UPS (Uninterrupted Power Supply)		
	4.1.1	The UPS shall be TRUE ONLINE type with DOUBLE CONVERSION.	
	4.1.2	Manual bypass switch shall be built in the UPS unit for maintenance purpose. While the manual bypass switch is selected, the system shall be capable of operating without any interruption of the system operation.	
	4.1.3	When the UPS is fault (e.g. overcharging, short circuit, overload, etc.) for short period, it shall be capable of automatically transferring the load supplied by the inverter to the reserve line (BYPASS) without any interruption of the system operation. In case of long period, the UPS shall be automatically shutdown.	
	4.1.4	About the UPS battery system	
		4.1.4.1	Protection mechanism shall be provided against damage of semiconductors due to the battery polarity being inadvertently reversed.
		4.1.4.2	The battery charger shall be capable of charging batteries being completely discharged with high quality.
		4.1.4.3	The battery shall also be continuously float charged.
	4.1.5	The tenderer shall verify that the proposed (either internal or external) BACKUP battery of the UPS system, is capable of time backup not less than 30 minutes at FULL LOAD. After considering high-powered (1,000W) DME and backup time, If the calculation result indicate that UPS 5 KVA is used, thus STS 32 A shall be applied; However, if the UPS 10 KVA is used, STS 45 A shall be applied.	

	4.1.6	The contractor shall be responsible for demonstrating a complete FULL LOAD field test of the complete power supply system whether compatible with AEROTHAI backup generator. Then, the contractor shall provide, install, and test the complete operable system in the specified location, whether compliant with the concept proposed earlier [4.1.5].			
	4.1.7	Technical specification of UPS			
		4.1.7.1	Input		
			4.1.7.1.1	Voltage (Vrms)	(220 or 230 VAC) ± 15% or better
			4.1.7.1.2	Frequency	50 Hz ± 5% or better
			4.1.7.1.3	Phase	Single (2 Wire + GND)
			4.1.7.1.4	THD (Total Harmonic Distortion)	≤ 10% or better at full load
		4.1.7.2	Output		
			4.1.7.2.1	Voltage (Vrms)	(220 or 230 VAC) ± 2% or better for both NORMAL and BATTERY mode
			4.1.7.2.2	Frequency	50 Hz ± 0.5% or better for both NORMAL and BATTERY mode
			4.1.7.2.3	Phase	Single (2 Wire + GND)
			4.1.7.2.4	THD (Total Harmonic Distortion)	≤ 3% for 100% linear load
			4.1.7.2.5	Waveform	Sine Wave
			4.1.7.2.6	Power Factor	0.8 lag or better
			4.1.7.2.7	Crest Factor	3:1 or better
			4.1.7.2.8	AC to AC - Overall Efficiency	≥ 85% at full load
		4.1.7.3	Overload Capacity		
			4.1.7.3.1	125% load	1 minute or better
		4.1.7.4	Environment		
			4.1.7.4.1	Ambient Temperature	0 °C to +40 °C (continuous or better)
			4.1.7.4.2	Humidity	90% continuously with non condensing

		4.1.7.5	Audible Noise		
			4.1.7.5.1	Audible Noise	≤ 55 dB(A) at 1 metre
		4.1.7.6	Battery		
			4.1.7.6.1	Type	Maintenance free sealed lead acid
			4.1.7.6.2	Frame	ABS
			4.1.7.6.3	Discharge	High rate discharge
			4.1.7.6.4	Life Time	3 to 5 years at 25°C or better
			4.1.7.6.5	Backup Time	≥ 30 minutes at full load of UPS
			4.1.7.6.6	Battery Standard	UL series or compatible
		4.1.7.7	UPS Standard		
			4.1.7.7.1	UPS Standard	มอก.1291-2545, IEC 62040 series EN50091 series, or compatible
	4.1.8	The monitoring & control equipment for UPS & STS is described in [5]. The complete "Intersystem Connection and Communication Diagram" is described in [8].			
4.2	STS (Static Transfer Switch)				
	4.2.1	STS shall be able to configured to transfer to another UPS source, by both AUTO and MANUAL method. For maintenance purpose, MANUAL TRANSFER (the so-called "MAINTENANCE BYPASS") is typically used for directing the specific source of UPS to load, not passing through to the automatic section. Additionally, MANUAL TRANSFER must be operated in an interlock way (Fig. 4-3).			
	4.2.2	STS shall transfer only when the UPS source not working properly. If the load (downstream circuit) is short, STS shall not transfer, in order for preventing damages expand to the upstream source.			
	4.2.3	STS shall be able to RETRANSFER, or back to the DEFAULT source of UPS, when that source is back to the normal condition.			
	4.2.4	The contractor shall be responsible for demonstrating a complete FULL LOAD field test of the complete power supply system whether compatible with AEROTHAI backup generator. Then, the contractor shall provide, install, and test the complete operable system in the specified location, whether compliant with the concept proposed earlier [4.1.5].			

	4.2.4	Technical specification of STS		
		4.2.4.1	Input Voltage (Vrms)	220 VAC ± 10% (adjustable) or better
		4.2.4.2	Output Voltage (Vrms)	220 VAC ± 10% (adjustable) or better
		4.2.4.3	Frequency	50 Hz ± 5% or better
		4.2.4.4	Phase	Single (2 Wire + GND)
		4.2.4.5	Rating	STS 32 A for UPS 5 KVA or, STS 45 A for UPS 10 KVA
		4.2.4.6	Overload Capacity (110%)	1 minute or better
		4.2.4.7	Transfer Time	≤ 5 ms for automatic transfer ≤ 10 ms for manual transfer
		4.2.4.8	Communication Port	RS232 standard and TCP/IP
		4.2.4.9	Standard	IEC 62310 series (or compatible)
	4.2.5	The monitoring & control equipment for UPS & STS is described in [5]. The complete “Intersystem Connection and Communication Diagram” is described in [8].		

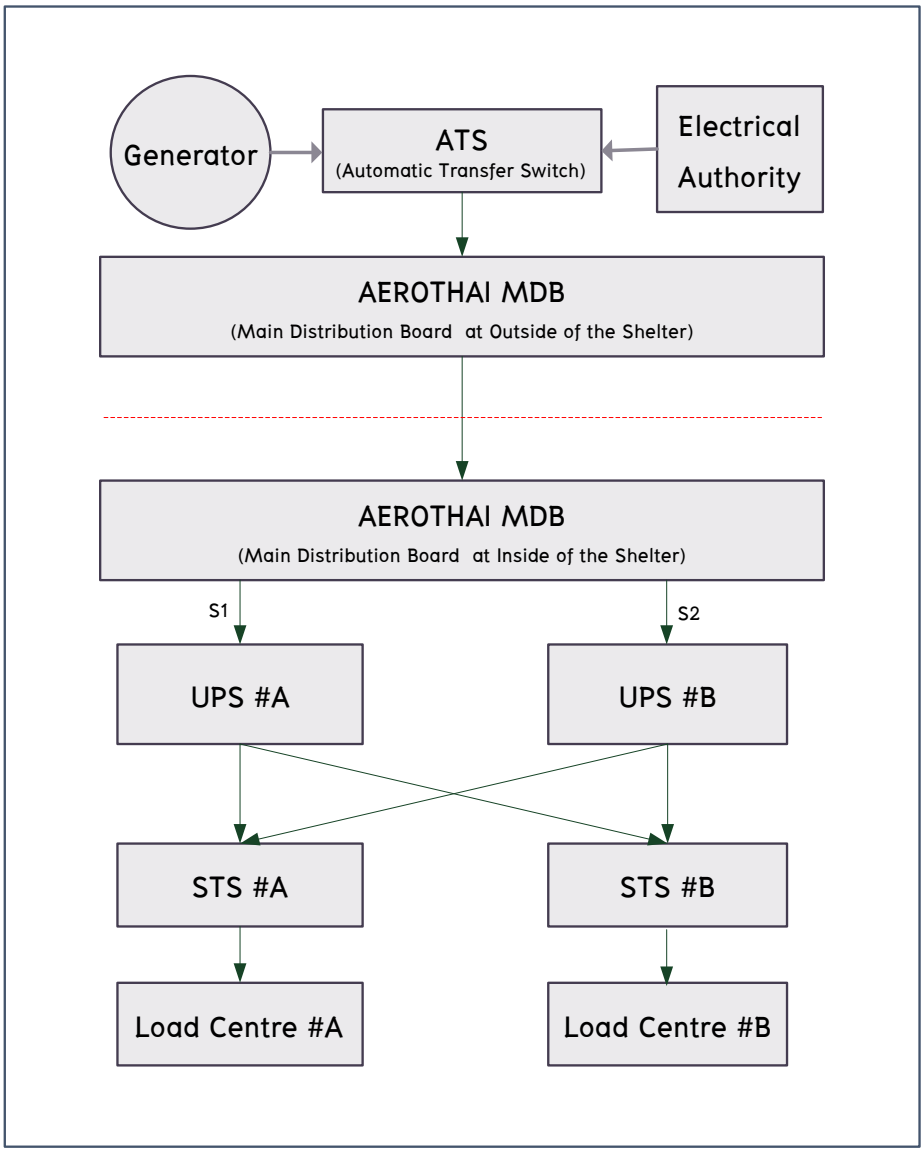
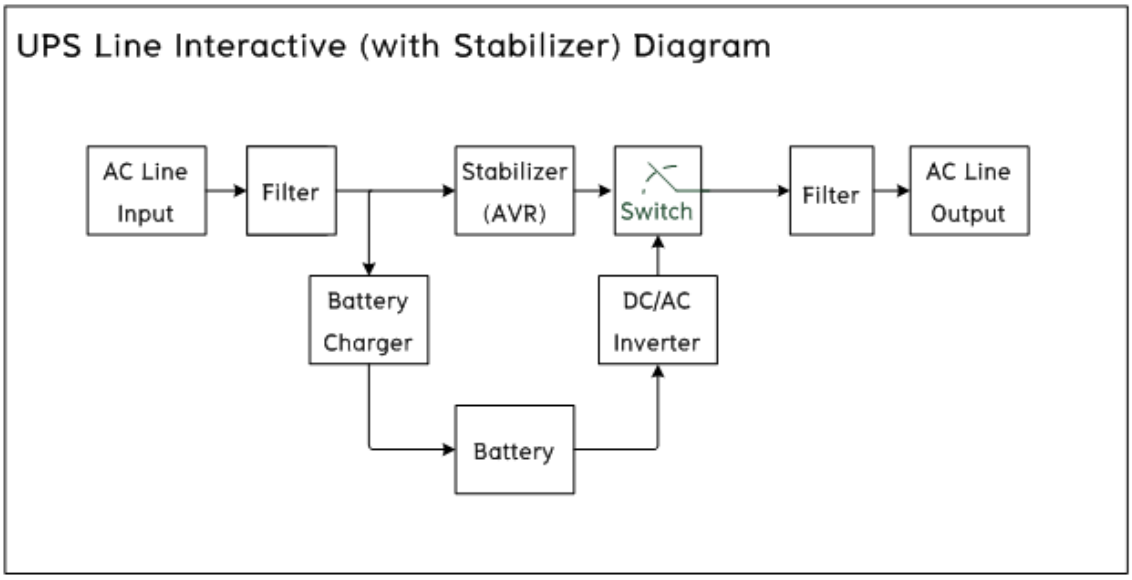


Figure 4-1 : Conceptual Diagram of Power Supply Configuration

Remark :

1. Both UPS #A and UPS #B are supplied with the electrical power from AEROTHAI MDB.
2. The specification of circuit breakers (load centres) and all associated wires, provided by the contractor, must also be complied with the rate of the UPSs.
3. Fig 4-1, is just a conceptual diagram, the real installation work may be adapted, depend on the personnel in charge; However, being still complied with the standard of ELECTRICAL AUTHORITY.



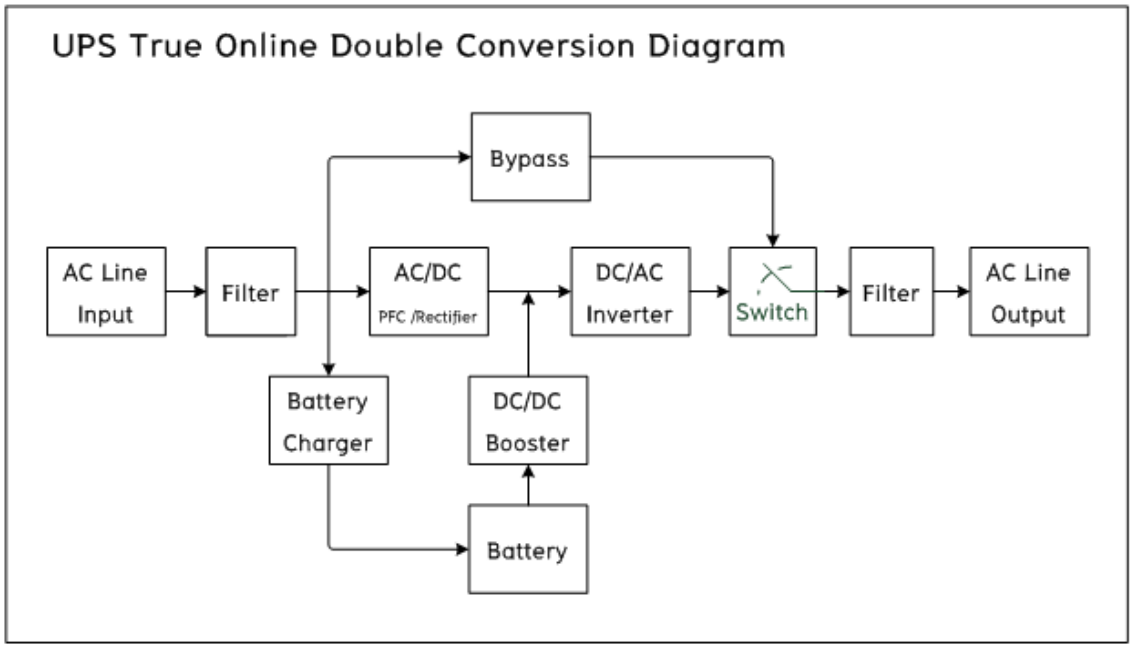


Figure 4-2 : A Comparison of Block Diagrams of Different Types of UPSs.

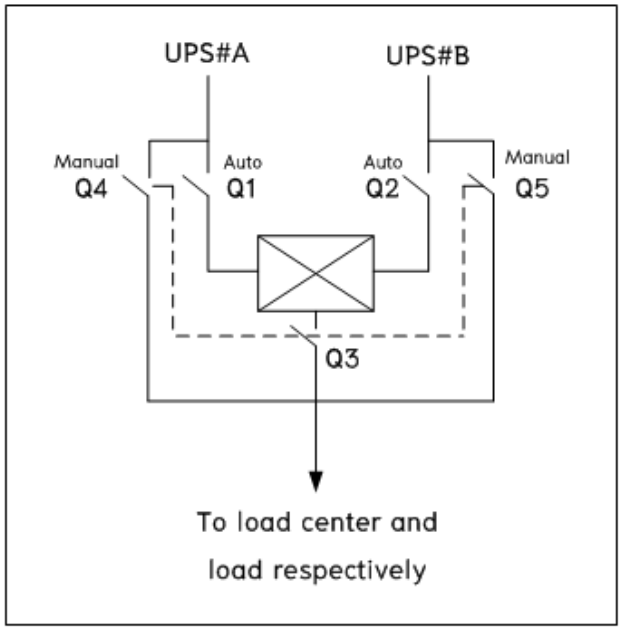


Figure 4-3 : Schematic Diagram of STS

5. Specification of Monitoring and Control System [E]

The complete system for monitoring and controlling of each DME, UPS and STS shall consist of the following :

1. LCSU and LMM computer.
2. RCSU and RSU (where RSU is only used for supporting DME).
3. RMM computer, notebook computer and color laser printer.
4. Central Monitoring System (developed by AEROTHAI).

Each unit described above, used to inform the system information (or some units can also enable control function to the system) to all relevant users at the different location, as described in Fig. 8-1, 8-2 and 8-3 respectively. Each unit shall be able to provide information about warning / alarm both in AUDIBLE and VISUAL mode (e.g. graphic with clear alarm messages which be able to diagnose the faulty component accurately) including log alarm histories with accurate / no drift of mmddyy & time stamp.

NOTE :

1. LMM computer for DME, UPS and STS shall be the same unit.
2. RMM computer for DME, UPS and STS shall be the same unit.
3. RCSU of UPS and RCSU of STS shall be combined to the same unit, the so-called *"RCSU of UPS & STS"*.

5.1	Local Control and Status Unit (LCSU) and LMM computer	
	5.1.1	LCSU is a unit used for monitoring and controlling the equipment LOCALLY at each DME, UPS and STS equipment. There are three (3) parts of LCSU -- LCSU of DME, LCSU of UPS and LCSU of STS. Typically, all of them are built-in module/CCA of each equipment.
	5.1.2	LCSU of DME shall provide the functions described in Table 5.1. LCSU of UPS shall provide at least, mimic diagram monitoring (e.g. line input, inverter, output, load on bypass, battery mode and fault - main fail, low battery, overload -, etc.) including some necessary control functions. LCSU of STS shall provide at least, mimic diagram monitoring and some necessary control functions.
	5.1.3	A desktop computer provided at each DME station, the so-called *"LMM Computer"*, stated as a part of LOCAL monitoring and controlling unit, shall be complied with [7.1]. The software for monitoring and controlling the DME, UPS and STS equipment shall be commonly installed in the same LMM computer. Each operating system shall be WINDOWS-BASED. The recovery CD/DVD and the user's license for the software shall be provided for AEROTHAI.
5.2	Remote Control and Status Unit (RCSU)	
	5.2.1	RCSU is a unit used for monitoring and controlling the equipment REMOTELY at the technical control room of ATC tower. There are three (3) parts of RCSU -- RCSU of DME, RCSU of UPS and RCSU of STS. RCSU of UPS and RCSU of STS shall be combined to the same unit, the so-called *"RCSU of UPS & STS"*.

	5.2.2	RCSU of DME shall provide the functions described in Table 5.1. RCSU of UPS & STS shall provide at least, mimic diagram monitoring (e.g. line input, inverter, output, load on bypass, battery mode and fault - main fail, low battery, overload -, etc.) including some necessary control functions.
	5.2.3	(Reserved)
	5.2.4	The network interconnections between each equipment (DME, UPS and STS) and their RCSUs shall be configured in a redundant manner (see also Fig. 8-1, 8-2, and 8-3) -- The primary connection and the secondary connection. The selection capability of using which connection shall also be provided.
	5.2.5	The system information OUTPUT (e.g. warning & alarm status / messages or else monitoring parameters) of each RCSU shall support *"Simple Network Management Protocol (SNMP)"* for AEROTHAI self developing the CENTRAL MONITORING SYSTEM in the future.
5.3	Remote Status Unit (RSU)	
	5.3.1	RSU is a unit used for only monitoring the equipment REMOTELY at the ATC room of ATC tower. There are one (1) parts of RSU -- RSU of DME. RSU of UPS & STS is not used. The contractor does not submit the proposal.
5.4	Remote Maintenance Monitoring (RMM)	
	5.4.1	RMM is a unit used for monitoring and controlling the equipment REMOTELY at the technical control room of ATC tower. There are three (3) parts of RMM -- RMM of DME, RMM of UPS and RMM of STS. All RMM software are installed in the same desktop computer -- RMM computer [5.4.3].
	5.4.2	RMM of DME shall provide the functions described in Table 5.1. RMM of UPS shall provide at least, mimic diagram monitoring (e.g. line input, inverter, output, load on bypass, battery mode and fault - main fail, low battery, overload -, etc.) including some necessary control functions.

		RMM of STS shall provide at least, mimic diagram monitoring and some necessary control functions.
	5.4.3	A desktop computer provided at the technical control room of ATC tower, the so-called *"RMM Computer"*, stated as a part of REMOTE monitoring and controlling unit, shall be complied with [7.1]. The software for monitoring and controlling the DME, UPS and STS equipment shall be commonly installed in the same RMM computer. Each operating system shall be WINDOWS-BASED. The recovery CD/DVD and the user's license for the software shall be provided for AEROTHAI. A Notebook computer and a color laser printer shall also be included in parts of the RMM.
	5.4.4	The network interconnections between each equipment (DME, UPS and STS) and their RMM shall be configured in a redundant manner (see also Fig. 8-1, 8-2, and 8-3) -- The primary connection and the secondary connection. The selection capability of using which connection shall also be provided.
	5.4.5	(Reserved)

Table 5.1 : The functions of each monitoring & controlling subsystem of the DME equipment.

ID	Functions	LCSU	RCSU	RSU	RMM
1	Display the equipment status and generate VISUAL & AUDIO warning / alarm when those occur.	X	X	X	X
2	Automatic transfer from the selected transponder to a standby transponder and / or shutdown in the event of an alarm.	X	-	-	-
3	Select the LOCAL / REMOTE control.	X	-	-	-
4	Select the MAIN / STANDBY equipment or at least turn ON / OFF and changeover the selected transponder with indicator.	X	X	-	X
5	BYPASS the monitor.	X	X	-	X
6	RESET / RESTART the system.	X	X	-	X
7	Adjust the system (both TRANSPONDER and MONITOR) parameter.	See [5.1.3]	-	-	See [5.4.3]

6. Specifications of Network Equipment for DME, UPS and STS Systems [E]

This section will detail all the network equipment necessary for implementing the REMOTE monitoring & control system. The monitoring & control equipment for DME, UPS and STS is described in [5]. The complete "Intersystem Connection and Communication Diagram" is described in [8].

6.1	Local Network Equipment (From DME equipment to technical control room)		Appeared in Fig. 8-1	8-2	8-3	Responsible by
	6.1.1	Optical fiber [6.5]	✓	✓	-	AEROTHAI
	6.1.2	Microwave link [6.6] (including its surge protection system)	✓	✓	-	AEROTHAI
	6.1.3	ISP (Internet Service Provider) media (see Fig.8-3)	-	-	✓	AEROTHAI
	6.1.4	L3 Switch [6.3]	✓	✓	✓	Contractor
	6.1.5	VPN router [6.4]	-	-	✓	Contractor
	6.1.6	Firewall [6.4]	-	-	✓	Contractor
	6.1.7	Serial to LAN converter (Only if DME equipment cannot provide RMM / RCSU Ethernet output [2.2.2.2], [2.2.2.3])	✓	✓	✓	Contractor
	6.1.8	Other equipment or accessories NOT mentioned above, but necessary to complete the network interconnection.	-	-	-	Contractor
6.2	Remote Network Equipment (From technical control room to central monitoring office at MAHAMEK)		Appeared in Fig. 8-1	8-2	8-3	Responsible by
	6.2.1	(Reserved)	-	-	-	AEROTHAI

6.3	L3 Switch Specifications The tenderers shall propose the technical specifications of the L3 Switch which comply with or are better than the following specifications.	
	6.3.1	Capable of switching and routing in both Layer 2 (data link) and Layer 3 (network)
	6.3.2	Forwarding bandwidth or Switching Capacity shall be at least 100 Gbps.
	6.3.3	Have at least 24 ports of RJ45 Gigabit Ethernet (10/100/1000 Mbps).
	6.3.4	2 ports of SFP Gigabit Ethernet or better, and 1 port of LX SFP
	6.3.5	The switch must be stackable up to 8 stack members.
	6.3.6	The stack throughput shall be up to 80 Gbps.
	6.3.7	Support 1,000 concurrent active VLANs or better.
	6.3.8	Can contain at least 8,000 MAC addresses.
	6.3.9	Support both IPv4 and IPv6.
	6.3.10	Support Static, RIP, RIPng, OSPFv2, OSPFv3 routing protocols.
	6.3.11	Configurable Access Control List for both IPv4 and IPv6
	6.3.12	Support IEEE 802.1X security authentication.
	6.3.13	Support Port Security, DHCP Protection, Dynamic ARP.
	6.3.14	Can be configured in link aggregation which complies with IEEE 802.3ad standard.
	6.3.15	Support Spanning Tree protocol as specified in IEEE 802.1D standard.
	6.3.16	Capable of both ingress and egress port mirroring from a port on either the same device or other devices.
	6.3.17	Manageable with CLI, GUI, SSH, SNMPv2c/3
	6.3.18	Compatible with 220 V 50 Hz power
6.4	Firewall and VPN Router Specifications The tenderers shall propose the technical specifications of the Firewall and VPN Router which comply with or are better than the following specifications.	
	6.4.1	Categorized as Next Generation Firewall Appliance.
	6.4.2	Have at least 1 Console port.
	6.4.3	At least 8 ports of 10/100/1000 Mbps Base-T
	6.4.4	Firewall throughput with Application Control shall not be less than 250 Mbps.

	6.4.5	Firewall throughput with IPS shall not be less than 100 Mbps.
	6.4.6	VPN throughput (IPSec Encryption) shall be at least 50 Mbps.
	6.4.7	Capable of IPSec tunneling for at least 50 tunnels
	6.4.8	Support IPv4 and IPv6
	6.4.9	Support Static, RIP, OSPFv2/v3 with graceful restart, BGP with graceful restart routing protocols.
	6.4.10	Support Bidirectional Forwarding Detection (BFD)
	6.4.11	Support Point-to-Point Protocol over Ethernet (PPPoE).
	6.4.12	Support Routing Policy-based forwarding
	6.4.13	Support IPv4 Network Address Translation (NAT) with both static and dynamic IP, and support Port Address Translation (PAT).
	6.4.14	Capable of Dynamic Site-to-Site IPSec VPN configuration
	6.4.15	Support the following IPSec Key Exchange types: Manual Key, Pre-shared Key, Certificate-based.
	6.4.16	Support 3DES and AES (128 bits, 256 bits) IPSec Encryption.
	6.4.17	Support the following IPSec Authentication types: MD5, SHA-1, SHA-256, SHA-384, SHA-512
	6.4.18	Capable of creating at least 4000 VLANs each of which complies with 802.1q standard
	6.4.19	Can be configured in link aggregation which complies with IEEE 802.3ad standard.
	6.4.20	Support Active/Passive High Availability.
	6.4.21	At least 50 GB of internal storage
	6.4.22	Manageable with CLI, GUI, SSH, SNMPv2c/3
	6.4.23	Compatible with 220 V 50 Hz power
6.5	Optical Fiber System Specifications (Reserved due to it is AEROTHAI's responsibility).	
6.6	Microwave Link (including its surge protection system) Specifications (Reserved due to it is AEROTHAI's responsibility).	

7. Specifications of Desktop Computer and Notebook Computer

7.1	Desktop Computer The tenderers shall provide the Desktop Computer including all attached devices that are installed for system operation and monitoring. The tenderers shall propose the technical specifications of the Desktop Computer which comply with or are better than the following specifications.		
	7.1.1	Desktop, display and keyboard shall be produced from the same manufacturer with permanent logo/brand on products.	
	7.1.2	Processor/Chipset	
		7.1.2.1	6^{th} Generation Intel Core i5
		7.1.2.3	Base clock frequency – 3.2 GHz
	7.1.3	RAM	
		7.1.3.1	Technology – DDR4 SDRAM
		7.1.3.2	Memory speed – 2133 MHz
		7.1.3.3	Capacity – 8 GB
	7.1.4	One (1) Hard Disk Drive	
		7.1.4.1	Capacity – 1.0 TB
		7.1.4.2	Interface – Serial ATA
	7.1.5	One (1) Optical Disc Drive	
		7.1.5.1	Internal DVD +/- RW Drive
	7.1.6	Graphic Controller	
		7.1.6.1	Intel built-in graphic
	7.1.7	One (1) Display	
		7.1.7.1	21.5 inches LED with resolution 1920 x 1080 pixels
	7.1.8	Networking	
		7.1.8.1	Built-in on board
		7.1.8.2	10/100/1000 Mbps Ethernet
		7.1.8.3	RJ-45 interface type
	7.1.9	Audio Output	
		7.1.9.1	Sound output including speakers
	7.1.10	I/O Interfaces	

		7.1.10.1	Minimum USB3.0 port – 2 ports
		7.1.10.2	Minimum total USB ports including USB2.0, USB3.0, USB3.1 – 4 ports
		7.1.10.3	One (1) Serial port or one (1) conversion device for converting USB to Serial port
	7.1.11	One (1) Keyboard	
		7.1.11.1	Standard QWERTY keyboard with USB interface
		7.1.11.2	104 keys at minimum
		7.1.11.3	Each key shall be permanently printed with both Thai and English characters.
	7.1.12	One (1) Mouse	
		7.1.12.1	Optical Mouse with scroll wheel
		7.1.12.2	USB interface
		7.1.12.3	A suitable mouse pad
	7.1.13	Operating System / Software	
		7.1.13.1	Shall be installed with the Desktop Computer
		7.1.13.2	Capable of operating with the software of the proposed DME system
		7.1.13.3	Recovery DVD with a copyright shall be provided.
	7.1.14	Compliant Standards	
		7.1.14.1	FCC or UL or CSA or ETL
	7.1.15	The operating system and license which is suitable for computer operation shall be provided.	
	7.1.16	One (1) set of office table and chair which is suitable for computer operation shall be provided.	
	7.1.17	The seller shall provide to the Desktop Computer a two (2) year manufacturer warranty which starts from the completion of the fifth payment date according to the term of payment stipulated in non-technical term of reference.	
	7.1.18	The Desktop Computer shall have a manufacturer branch office authorized representative in Thailand.	

	7.1.19	The manufacture of the Desktop Computer shall receive ISO 9000 series certification.	
	7.1.20	The DVD for software driver shall be provided with the product.	
7.2	Notebook Computer The Tenderers shall provide the Notebook Computer including all attached devices that are installed for system operation and monitoring. The Tenderers shall propose the technical specifications of the Notebook Computer which comply with or are better than the following specifications.		
	7.2.1	Processor/Chipset	
		7.2.1.1	6^{th} Generation Intel Core i7
		7.2.1.2	Base clock frequency: 2.5 GHz
	7.2.2	RAM	
		7.2.2.1	Technology: DDR3 or DDR4 SDRAM
		7.2.2.2	Memory speed: 1600 MHz for DDR3 or 2133 MHz for DDR4
		7.2.2.3	Capacity: 8 GB
	7.2.3	One (1) Hard Disk Drive	
		7.2.3.1	Capacity: 1.0 TB
		7.2.3.2	Interface: Serial ATA
	7.2.4	One (1) Optical Disc Drive	
		7.2.4.1	Internal DVD +/- RW Drive
	7.2.5	Graphic Controller	
		7.2.5.1	AMD graphic with a minimum of 2 GB dedicated memory
	7.2.6	One (1) Display	
		7.2.6.1	14 or 15 inches LED with resolution 1366 x 768 pixels
	7.2.7	Internal Wireless LAN	
		7.2.7.1	Compliant with IEEE 802.11b/g/n standard
	7.2.8	Networking	
		7.2.8.1	Built-in on board
		7.2.8.2	10/100/1000 Mbps Ethernet
		7.2.8.3	RJ-45 interface type

	7.2.9	Audio Output	
		7.2.9.1	Sound output including built-in stereo speakers
	7.2.10	I/O Interfaces	
		7.2.10.1	Minimum USB3.0 port – 1 port
		7.2.10.2	Minimum total USB ports including USB2.0, USB3.0, USB3.1 – 3 ports
		7.2.10.3	One (1) Serial port or one (1) conversion device for converting USB to Serial port
		7.2.10.4	One (1) VGA port or one (1) conversion device for converting existing display output port to VGA port
	7.2.11	One (1) Keyboard	
		7.2.11.1	Each key shall be permanently printed with both Thai and English characters.
	7.2.12	One (1) Mouse	
		7.2.12.1	Optical Mouse with scroll wheel
		7.2.12.2	USB interface
		7.2.12.3	A suitable mouse pad
	7.2.13	Pointing Device	
		7.2.13.1	Touchpad
	7.2.14	Battery	
		7.2.14.1	Lithium Ion rechargeable
	7.2.15	Operating System / Software	
		7.2.15.1	Shall be installed with the Notebook Computer
		7.2.15.2	Capable of operating with the software of the proposed DME system
		7.2.15.3	Recovery DVD with a copyright shall be provided.
	7.2.16	Compliant Standards	
		7.2.16.1	FCC or UL or CSA or ETL
	7.2.17	The operating system and license which is suitable for computer operation shall be provided.	
	7.2.18	The Desktop Computer shall have a manufacturer branch office authorized representative in Thailand.	
	7.2.19	The manufacture of the Desktop Computer shall receive ISO 9000 series certification.	

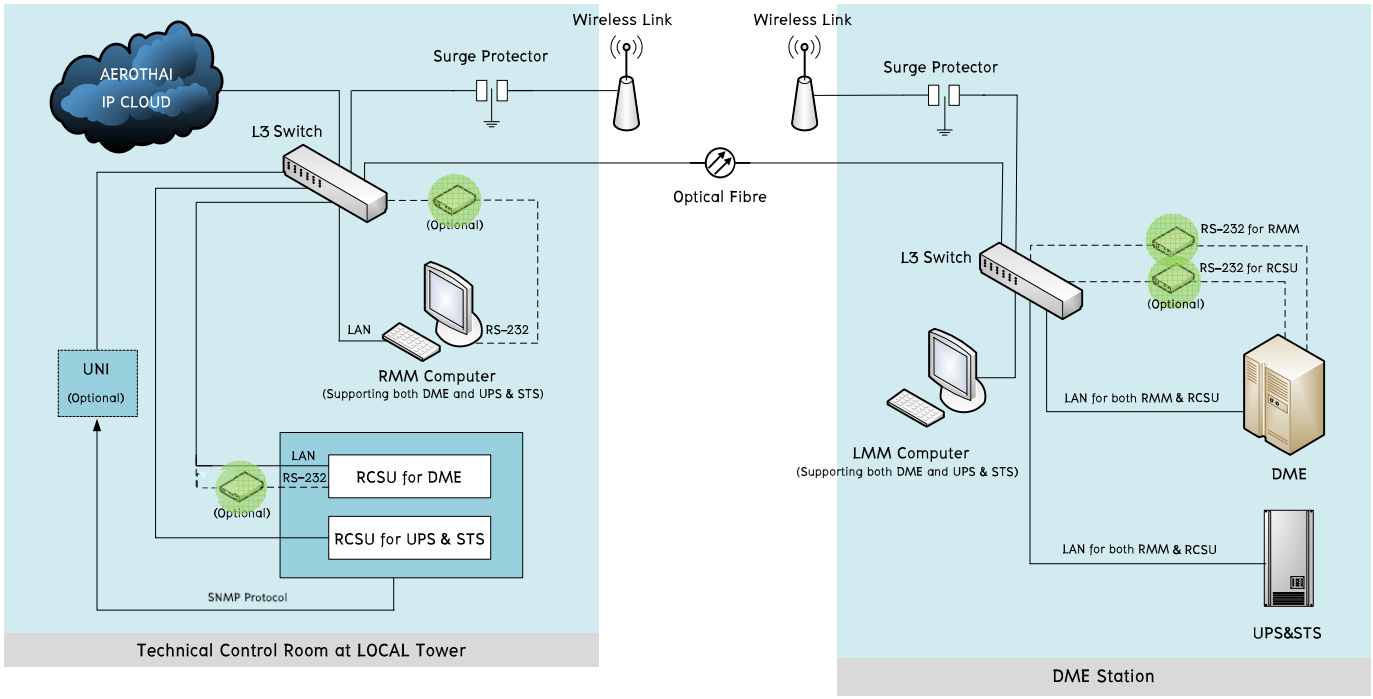
	7.2.20	Operating manual and the DVD for software driver shall be provided with the product.
	7.2.21	One (1) suitable-sized carrying case shall be provided with the Notebook Computer.
	7.2.22	The weight of Notebook Computer including battery shall not exceed 2.2 Kilograms.
	7.2.23	The seller shall provide to the Notebook Computer a two (2) year manufacturer warranty which starts from the completion of the fifth payment date according to the term of payment stipulated in non-technical term of reference.

8. Intersystem Connection and Communication Diagram [E]

The MONITORING & CONTROL equipment for DME, UPS and STS is described in [5]. The NETWORK equipment necessary for implementing the REMOTE monitoring & control system is described in [6]. This section will depict the integration of all above equipment to a complete system.

8.1	The tenderer shall submit the proposal of intersystem connection and communication diagram (see Fig. 8-1, 8-2, and 8-3 for conceptual design and Table 8-1 for summary).	
8.2	For redundancy purpose. The network interconnection between the DME station and the associated remote monitoring & control system (RCSUs and RMM computer) shall be provided via primary connection and secondary connection. The priority of the connections is optical fiber, microwave link, and ISP (Internet Service Provider) media, respectively (see Fig. 8-1 to 8-3)	
8.3	The contractor shall provide the following equipment.	
	8.3.1	Monitoring & control equipment : LMM computer, RCSU of DME, RCSU of UPS & STS, RSU of DME, RMM computer
	8.3.2	Local network equipment as stated in [6.1.4] to [6.1.8]
8.4	The contractor shall provide or detail the information exchange (e.g. standard documents, interface control documents (ICDs), etc.) at the output of RCSU for AEROTHAI self developing the CENTRAL MONITORING SYSTEM.	
8.5	The contractor shall provide the protection system [2.6] to prevent all equipment from damages in the event of a lightning strike.	
8.6	The contractor shall provide or detail the mechanism to provide data integrity and security against unauthorized access, intrusion and malicious computer attacks.	

DME Network Type A (e.g. SUKHOTHAI, etc.)

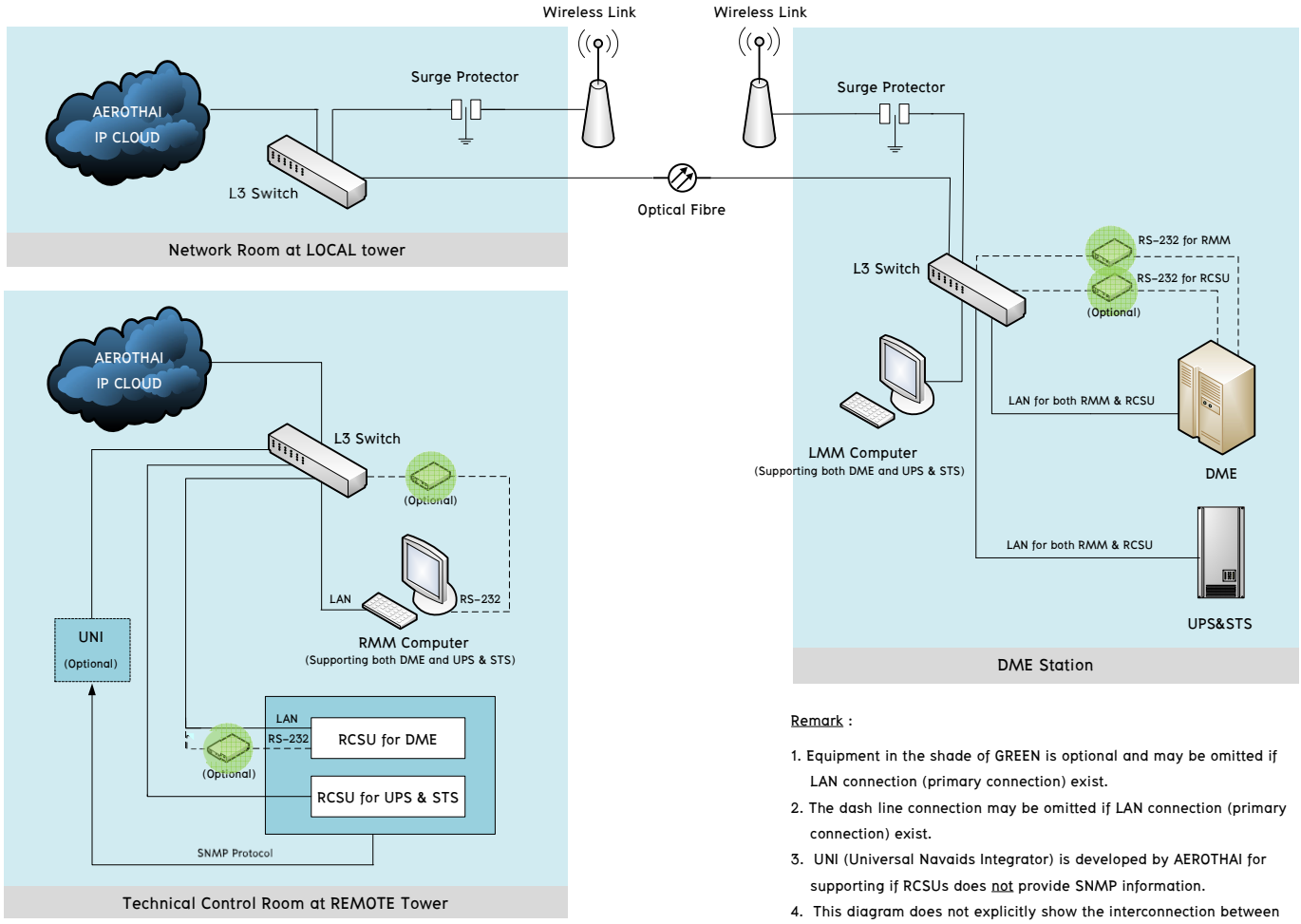


Remark :

1. Equipment in the shade of GREEN is optional and may be omitted if LAN connection (primary connection) exist.
2. The dash line connection may be omitted if LAN connection (primary connection) exist.
3. UNI (Universal Navaids Integrator) is developed by AEROTHAI for supporting if RCSUs does not provide SNMP information.
4. This diagram does not explicitly show the interconnection between AEROTHAI IP cloud and CENTRAL monitoring office at MAHAMEK.

Fig. 8-1 : Type A - Network / Interconnection of DME and UPS & STS System
(DME station and technical control room at the same air site)

DME Network Type B (e.g. TAK, etc.)

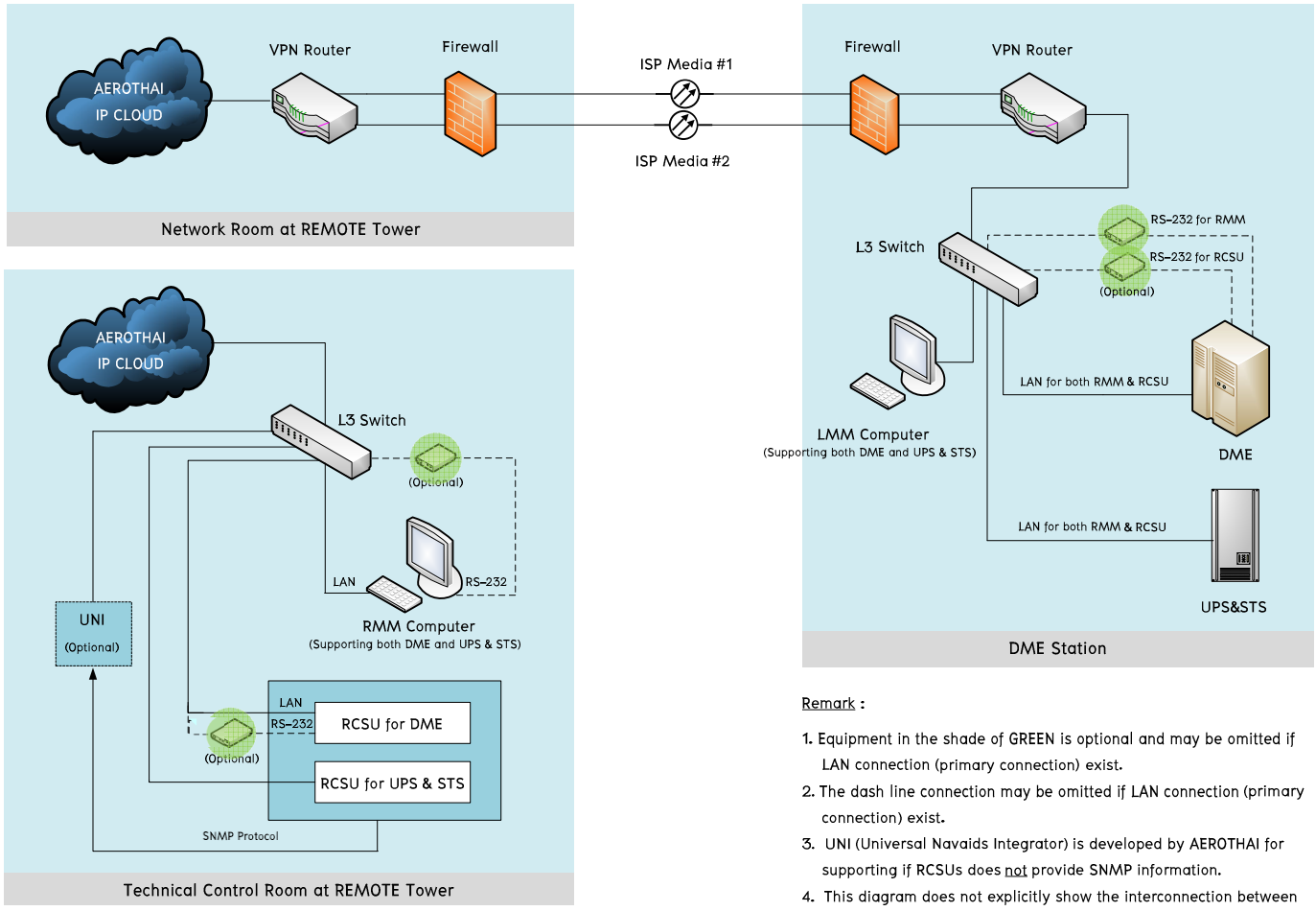


Remark :

1. Equipment in the shade of GREEN is optional and may be omitted if LAN connection (primary connection) exist.
2. The dash line connection may be omitted if LAN connection (primary connection) exist.
3. UNI (Universal Navaids Integrator) is developed by AEROTHAI for supporting if RCSUs does not provide SNMP information.
4. This diagram does not explicitly show the interconnection between AEROTHAI IP cloud and CENTRAL monitoring office at MAHAMEK.

Fig. 8-2 : Type B - Network / Interconnection of DME and UPS & STS System
(DME station and technical control room at the different air site, IP Cloud support at the LOCAL air site)

DME Network Type C (e.g. PRACHINBURI, etc.)



Remark :

1. Equipment in the shade of GREEN is optional and may be omitted if LAN connection (primary connection) exist.
2. The dash line connection may be omitted if LAN connection (primary connection) exist.
3. UNI (Universal Navaids Integrator) is developed by AEROTHAI for supporting if RCSUs does not provide SNMP information.
4. This diagram does not explicitly show the interconnection between AEROTHAI IP cloud and CENTRAL monitoring office at MAHAMEK.

Fig. 8-3 : Type C - Network / Interconnection of DME and UPS & STS System
(DME and technical control room at the different air site, None IP Cloud support at the LOCAL air site)

Table 8.1 : Summary of the DME station with appropriate network type.

ID	NAME OF INSTALLATION LOCATION	New Shelter	RCSU Location	Network Type	Remark
1	AEROTHAI-PRACHINBURI (NDB)	-	DON MUEANG	Type C	
2	AEROTHAI-SUKHOTHAI (NDB)	-	SUKHOTHAI	Type A	
3	AEROTHAI –TAK (NDB)	-	PHITSANULOK	Type B	
4	TREASURY-PHUKET /KHAO BANG DOOK (RCAG)				
5	RTAF-SATTAHIP /KHAO MON (RCAG)				
6	RTAF-SAMUI /KHAO POM (RCAG)				
7	RTAF-KAMPHAENG SAEN (DME)				
8	RTAF-LOP BURI (TACAN)				
9	RTAF-TAKHLI (TACAN)				
10	RTAF-WATTHANA NAKHON (NDB)				
11	MCOT CH9-RANONG /KHAO MUEANG				
12	MCOT CH9-SURAT /KHAO THA PET				
13	MCOT CH9-RAYONG /KHAO YAI DAR				
14	MCOT CH9-PRACHUAB				
15	CAT-HATYAI /KHAO KOR HONG				

Pending for Phase II & III

9. Requirements of Spare Parts

The details of spare parts for each DME and UPS & STS equipment shall be complied with the following.	
9.1	Each of the DME equipment shall be provided with the spare parts of 100%, where 100% means a complete set for single system configuration, e.g. line replaceable module (LRM), circuit card assembly (CCA), backplanes, and RF switches (coaxial relays), etc. Double LED obstruction light [3.3.5] for DME antenna system shall also be provided with the spare parts of 100%.
9.2	Each of RCSU of DME [5.2] and RSU of DME [5.3] shall be provided with the spare parts of 100%. Thus the spare parts of each of them shall consist of one (1) complete unit of each line replaceable module (LRM), circuit card assembly (CCA) and backplanes.
9.3	All spare parts related to UPS & STS equipment are not required. It is AEROTHAI's responsibility.
9.4	All spare parts related to network equipment [6] are not required. It is AEROTHAI's responsibility.
9.5	The contractor and manufacturer shall share responsibility of WARRANTY the EXTRA spare parts (not included in 100% of AEROTHAI), when additional purchase, still compatible with the existing DME system for a whole of 15 years -- the nominal lifetime of navigation aid equipment.

10. Tool Kits, Measuring Equipment and Maintenance Aids / Accessories

For installation, maintenance or else system calibration, all relevant equipment, aids, accessories and tool kits shall be provided as following:		
10.1	Materials and tool kits necessary for installation. (Reserved).	
10.2	Measuring equipment necessary for maintenance or else system calibration. (Reserved).	
10.3	Maintenance aids / accessories necessary for maintenance or else system calibration.	
	10.3.1	Extension cards and test cable of each module/CCA required for initial setup, maintenance or else system calibration (both transmitter and monitor calibration) shall be provided.
	10.3.2	Directional coupler, dummy load and attenuation kits required for initial setup, maintenance or else system calibration (both transmitter and monitor calibration) shall also be provided.

11. Technical Documents and Test Reports [E]

11.1	One (1) original and three (3) hard copies of Factory Acceptance Test (FAT) report shall be provided at the factory after the completion of FAT.	
11.2	For each DME station, One (1) original and two (2) hard copies of Site Acceptance Test (SAT) report shall be provided at the site after the completion of the commissioning flight check.	
11.3	For each DME station. The contractor shall provide the following documents:	
	11.3.1	A hard copy and a set of CD/DVD, of EQUIPMENT DESCRIPTION (e.g. functional concepts, block diagrams and significant signals) required for understanding the overall concept, function of each module/CCA till the relationships among of them.
	11.3.2	A hard copy and a set of CD/DVD, of OPERATIONS and MAINTENANCE required for operation, initial setup, maintenance or else system calibration.
	11.3.3	A hard copy and a set of CD/DVD, of ASSEMBLY DRAWINGS & SCHEMATIC DIAGRAM required for diagnostics or else repairing line replaceable modules (LRMs) or circuit card assembly (CCA).
	11.3.4	A hard copy and a set of CD/DVD, of PART LISTS of DME equipment.

ABBREVIATIONS

Abbreviations	Full Name
AEROTHAI	Aeronautical Radio of Thailand Ltd.
BITE	Built-in Test Equipment
CCA	Circuit Card Assembly
FAA	Federal Aviation Administration
ICAO	International Civil Aviation Organization
LCSU	Local Control Status Unit
LMM	Local Maintenance Monitoring
MTBF	Mean Time Between Failure
MTBO	Mean Time Between Outage
MTTR	Mean Time to Repair
RCSU	Remote Control and Status Unit
RMM	Remote Maintenance Monitoring
RSU	Remote Status Unit
SNMP	Simple Network Management Protocol
STS	Static Transfer Switch
UPS	Uninterrupted Power Supply

APPENDIX A

LIST OF THE NEW DME STATION LOCATION

ID	NAME OF THE STATION LOCATION	RESPONSIBILITY	EXPECTED COORDINATES			CH
			LATITUDE	LONGITUDE	ELEV	
1	AEROTHAI-PRACHINBURI (NDB)	DCA /AEROTHAI	14°7'7.10"N	101°22'15.30"E	19	110X
2	AEROTHAI-SUKHOTHAI (NDB)	BKK AIRWAYS /AEROTHAI	17°14'8.10"N	99°49'19.84"E	57	100X
3	AEROTHAI –TAK (NDB)	DCA /AEROTHAI	16°53'58.22"N	99°15'7.72"E	149	47X
4	TREASURY-PHUKET /KHAO BANG DOOK (RCAG)	TREASURY /AEROTHAI	8°8'1.94"N	98°19'46.62"E	249	102X
5	RTAF-SATTAHIP /KHAO MON (RCAG)	RTAF /AEROTHAI	12°41'19.2"N	100°55'14"E	246	71X
6	RTAF-SAMUI /KHAO POM (RCAG)	RTAF /AEROTHAI	9°29'32.95"N	99°59'14.4"E	615	75X
7	RTAF-KAMPHAENG SAEN (DME)	RTAF	14°9'56.8"N	99°57'15.5"E	7	59X
8	RTAF-LOP BURI (TACAN)	RTAF	14°52'52.19"N	100°39'47.91"E	36	33X
9	RTAF-TAKHLI (TACAN)	RTAF	15°16'44.66"N	100°17'50.87"E	29	31X
10	RTAF-WATTHANA NAKHON (NDB)	RTAF	13°45'13.71"N	102°18'50.84"E	72	111X
11	MCOT CH9-RANONG /KHAO MUEANG	MCOT-9	10°1'54.37"N	98°40'16.19"E	511	21X
12	MCOT CH9-SURAT /KHAO THA PET	MCOT-9	9°5'33.91"N	99°20'56.09"E	153	78X
13	MCOT CH9-RAYONG /KHAO YAI DAR	MCOT-9	12°40'26.66"N	101°24'43.28"E	496	107X
14	MCOT CH9-PRACHUAB	MCOT-9	11°54'21.42"N	99°48'3.51"E	236	23X
15	CAT-HATYAI /KHAO KOR HONG	CAT /DTAC	7°0'57.1"N	100°31'11.14"E	362	103X

SECTION 2

CIVIL WORK

รายละเอียดแบบรูปและรายละเอียดงานปรับปรุงของ สถานีเครื่องช่วยการเดินอากาศ DME สุโขทัย , สถานีเครื่องช่วยฯ NDB ตาก และ ปราจีนบุรี ตามเอกสารแนบ