TRANSCO ترانسكو

شركة أبو ظبي للنقل والتحكم

Abu Dhabi Transmission & Despatch Company

5-Year Electricity Planning Statement Update (2008-2012)

Main Report

DRAFT

Asset Management Directorate
Power Network Development Department

June 2007

Table of Contents

1 Introduction

Condition 15 of the Transmission Licence requires the Abu Dhabi Transmission and Despatch Company (TRANSCO) to submit its 5-Year Electricity Planning Statement annually in a form approved by the Regulation and Supervision Bureau (RSB or Bureau), showing the expected capacity, power flows, fault levels and loading on each part of Transmission System for the next five (5) years

TRANSCO's Planning Statement enables the Distribution Companies or any other entity seeking the use of the transmission system, to identify and evaluate the most suitable opportunities available for connection. Such opportunities shall be guided by the "Statement of Connection Charging Methodology for the TRANSCO Electricity System" approved by the Bureau on November 26, 2005 to make a reasonable estimate of the charges to which they would be liable for the provision of such services. The Planning Statement allows the Bureau to evaluate the efficiency of the proposed expansion plans as well as to check the coordination of such plans with other Sector Participants, in particular ADWEC and the Distribution Companies.

The Bureau is responsible for all matters relating to the technical performance of the Sector Companies and for ensuring the continued supply of electricity in the Abu Dhabi Emirate. The Sector structure, tariff regulations, information on the Licence Holders and Licences, details of the technical affairs, price controls, laws and regulations can be obtained from the website *http://www.rsb.gov.ae.* In order to fulfill its obligations, the Bureau reviews in detail the annual planning statements which are required from ADWEC, TRANSCO and the Distribution Companies. These statements give a forward view on the proposed expansion of infrastructure and new connections needed to meet the forecast demand growth. All of these statements shall be approved by the Bureau.

The structure of this 7th TRANSCO 5-Year Planning Statement (2008-2012) update contains the following main sections:

a) Executive Summary

This Chapter summarizes the electricity demand and generation capacity forecast update up to Year 2012 and highlights the major strategic plans for the electricity transmission system expansion for the next five (5) years.

b) Electricity Demand and Generation Capacity Forecast

In this Chapter, ADWEC's electricity demand and generation capacity forecast are highlighted. Based on the electrical connectivity and geographical dispersion, the electricity demand forecast is allocated among the existing and proposed demand supply points in Abu Dhabi Emirate.

c) Electricity Transmission System Planning Criteria

This Section sets out the planning criteria used for the planning and development of the electricity transmission system.

d) Electricity Transmission Expansion Plans

This Chapter shows the stage wise transmission system development topology proposed for the next five (5) years based on the current on-going & proposed projects and brief discussion of its implication on the system performance.

e) Strategic Plans and Opportunities

In this Chapter, TRANSCO's major strategic plans for the development of electricity transmission system for the next five (5) years to meet the electricity forecast demand and generation capacity expansion plans are highlighted. Also, the generation and demand supply opportunities are briefly described.

f) Metering, Data Exchange and Communication System

In this Chapter, the metering, data exchange and communication system expansion plans are briefly described.

2 Executive Summary

TRANSCO 5-Year Electricity Planning Statement (2008-2012) update is based on the ADWEC's base case peak demand forecast (most probable forecast scenario) for the Abu Dhabi Emirate. The base case peak system demand for Abu Dhabi Emirate will be expected to reach about 10,600MW in Year 2012. The estimated demand growth (2007-2012) excluding Mega Projects' requirements is 7.6%. For the same planning horizon, the estimated demand growth including Mega Projects is 14.8%. The demand requirements of the Mega Projects have significant influence on the updated load forecast model. As on May 2007, the demand outlook for the Northern Emirates (Fujairah & Ras Al Khaimah) is uncertain. For the purpose of this 5-Year Planning Statement, it is assumed the peak system demand for Northern Emirates is non-firm and around 1,300MW for Year 2012.

The total system demand of Abu Dhabi Emirate & Northern Emirates including auxiliary loads & losses will be about 11,900MW in Year 2012. Based on the ADWEC's updated statement of future generation capacity requirement (2007-2012) inclusive Fujairah capacity, the total "available generation capacity" and "required generation capacity" is expected to be around 12,800MW and 12,500MW respectively in Year 2012. The summary of electricity generation capacity and peak demand forecast for the planning horizon 2007-2012 is shown in Figure 1.

Table 1 shows the summary of available generation capacity, required generation capacity, peak demand of Abu Dhabi Emirate & Northern Emirates and estimated demand supply gap and transmission losses for the planning horizon 2007-2012. In view of uncertainty of the Northern Emirates' demand, ADWEC has not included the said demand in their computation of the "required generation capacity".

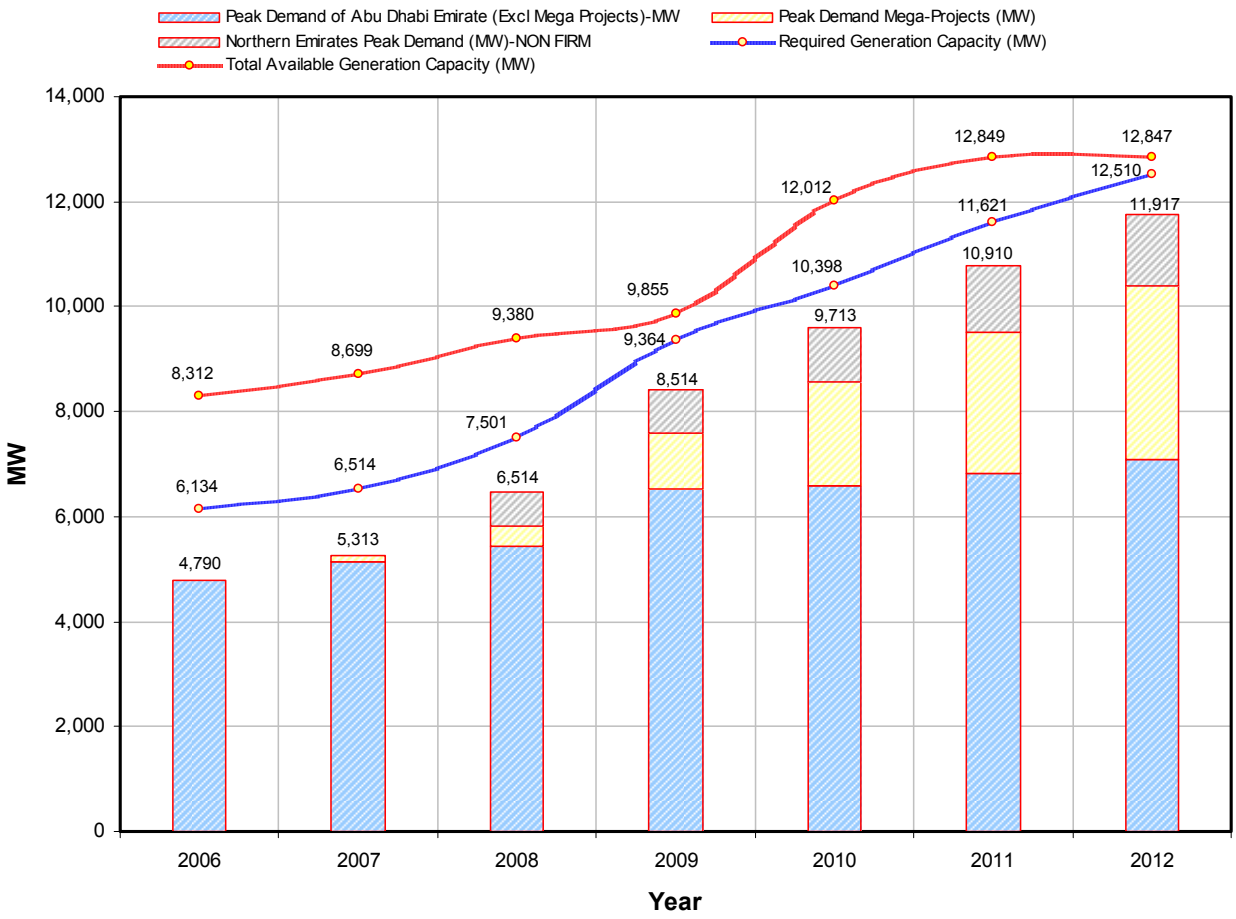

Fig. 1 Generation capacity and peak demand forecast for the planning horizon.

Table 1 Demand supply gap for the planning horizon 2007-2012.

S.N	Description	2006	2007	2008	2009	2010	2011	2012
1	Demand Forecast-Abu Dhabi Emirate (MW)	4,790	5,262	5,804	7,594	8,571	9,523	10,401
2	Demand Forecast-Northern Emirates (MW)			655	837	1,043	1,243	1,343
3	Total Demand (MW) #	4,790	5,262	6,459	8,431	9,614	10,766	11,744
4	Tranmission Losses (Output of PSS/E Load Flow Program)-MW		51	55	83	99	144	173
5	Grand Total Peak Demand (MW)	4,790	5,313	6,514	8,514	9,713	10,910	11,917
6	Total Available Gross Capacity including Fujairah (MW)	8,312	8,699	9,380	9,855	12,012	12,849	12,847
7	Required Capacity (ADWEC's Stochastic Output Program)-MW **	6,134	6,514	7,501	9,364	10,398	11,621	12,510
Demand Supply Gap (Required Capacity-Total Peak Demand) - MW		**1,344**	**1,201**	**987**	**850**	**685**	**711**	**593**

includes auxiliary loads as well such as substation & power station auxiliary loads and desalination process plant loads.

** Required capacity takes into account generation planning criteria & other factors such as forced outage rate, demand forecast error, spinning reserve. The required capacity assumes the Northern Emirates demand as **NON-FIRM**.

TRANSCO's major strategic plans for the development of electricity transmission system for the next five (5) years to meet the above-mentioned electricity forecast demand and generation capacity expansion plans are as follows;

a) The development of 400kV power evacuation facility from the Power Stations is based on realization of ADWEC's generation expansion plan (Taweelah-B Extension in Yr 2007, Fujairah Phase-2 Extension in Yr 2010 and Shuweihat Phase-2 in Yr 2011).

b) The 400kV circuit connections from Taweelah Sites are optimized to secure supply to Abu Dhabi Island & Mainland and cater for the demand requirements of the Mega Projects.

c) Realization of 400kV transmission ring to Abu Dhabi Island and hence enhancing the security of supply standard from N-1 to N-2. The 132kV transmission system in Abu Dhabi Island will be accordingly operated as three (3) sub-system zones (E19, E48 & ADST Zones) to ensure the 132kV fault levels are within the switchgear rating, maintain power flow balance and provide operational flexibility.

d) Strengthen the 400kV transmission network in the surrounding regions of the Abu Dhabi Island by integrating the proposed new 400/132kV grid stations (4 x 500MVA capacity) in REEM and SADIYAT to meet the demand requirements of Mega Projects in these Islands.

e) New 400/132kV grid station (4 x 500MVA capacity) in BAHIA and 400kV OHL interconnection works with TAWEELAH and SADIYAT. Power supply to the YAS ISLAND' development, new AIRPORT and RAHA developments will be fed from this grid station.

f) New 400/132kV grid station (4 x 500MVA capacity) in MAHAWI area to provide strong 400/132kV power supply infeed source to the said area for securing the existing demand and the upcoming demand requirements of

Mega Projects in that area and reconfiguration of selective 400kV & 220kV overhead line network.

g) Proposal to split the 132kV network configuration as three (3) sub-system zones (Umm Al Nar, Bahia and Mahawi) taking into account the new developments in Abu Dhabi Mainland.

h) Provide 400/220kV power supply infeed source in ICAD and adopt phased 220kV development to meet the demand requirements in Mussafah/ICAD industrial area.

i) Reinforce the 220kV interconnection facilities and enhance the substation capacity at BAB to meet the new demand requirements of ADCO.

j) Conversion of 220kV overhead lines to cables between 220/33kV substations namely Dhama, Al Ain Power Station, City Centre and Zakher.

k) Establish 400/220kV grid station (3 x 500MVA capacity) at Sweihan and connect to Fujairah & Taweelah to facilitate export of power from Fujairah to Abu Dhabi Emirate and ensure secure power supply to Al-Ain region.

l) Possible integration TRANSCO's electricity transmission system with that of Northern Emirates offers potential opportunity for the development of electricity transmission system in FUJAIRAH and RAS AL KHAIMAH.

m) Integrate the TRANSCO's 400kV transmission system with GCC Grid through Shuweihat as an interface node to share benefits such as reduced spinning reserve and facilitate future electricity trading among various Utilities in U.A.E and Gulf Region, if required.

n) Phased conversion of remaining 132kV oil filled cables to XLPE.

3 Electricity Demand and Generation Capacity Forecast Update

3.1 Electricity Demand Forecast Update

The Article 30, Sector Law No. 2 of 1998 requires ADWEC to prepare electricity demand forecast* and accordingly secure future generation capacity* requirements to meet the forecast demand. The forecast technique adopted by ADWEC is bottom-up approach that includes new population forecast based on 2005 Census, housing and farms development, industrial growth, demand forecast received from ADDC/AADC, demand notification from Mega Projects Customers, Government Agencies and others.

In February 2007, TRANSCO received the electricity demand forecast update (2007-2020) from ADWEC. The submitted forecast covers the future needs for the Abu Dhabi Emirate only. As on May 2007, the electricity demand outlook for the Northern Emirates (Fujairah & Ras Al Khaimah) is uncertain and NO confirmed data was received. Therefore, the electricity demand of Northern Emirates could be considered at this stage as non-firm, as per ADWEC's view.

Changes in "Land Ownership Laws" in Year 2005 and release of surplus oil revenue have resulted in major infrastructure development projects (Mega Projects) in Abu Dhabi Emirate. The new Mega Projects in Abu Dhabi Emirate has been incorporated in the load forecast model update to arrive at the sum of the area-wise system peak demand. Figure 2 shows the geographical map of Mega Development Projects in Abu Dhabi Emirate.

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* For latest and detailed electricity demand forecast and generation capacity expansion plans, USERs are advised to access such information from ADWEC's website www.adwec.ae or could request ADWEC for hardcopy of the said documents.

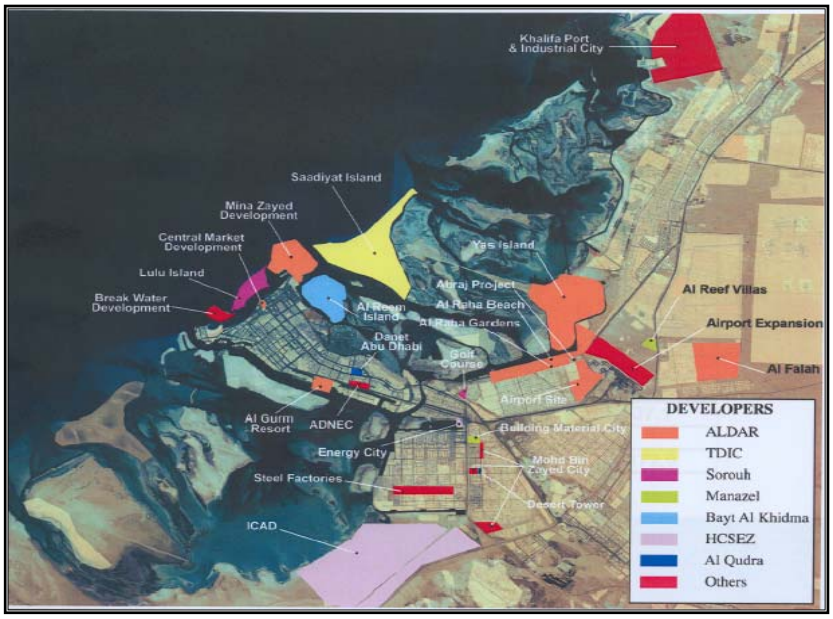


Fig. 2 Geo-Map of Mega Development Projects in Abu Dhabi Emirate.

ADWEC developed three (3) demand forecast scenario namely the high forecast, base case (most likely scenario) and low forecast for the Abu Dhabi Emirate due to the uncertainty in the timing/size of known Mega Projects. The key assumptions used by ADWEC to derive the coincident system peak demand forecast for the said regions are summarized below:

- District cooling is assumed to be installed in 50% of the Mega Projects.
- Demand factor 0.33 for high demand forecast scenario.
- Demand factor 0.28 and one (1) year delay in the developer's time schedule for the base case demand forecast scenario.
- Demand factor 0.23 and two (2) year delay in the developer's time schedule for the low demand forecast scenario.

The summary of the ADWEC's system peak demand forecast (2007-2012) for the Abu Dhabi Emirate for the three scenarios is shown in Figure 3.

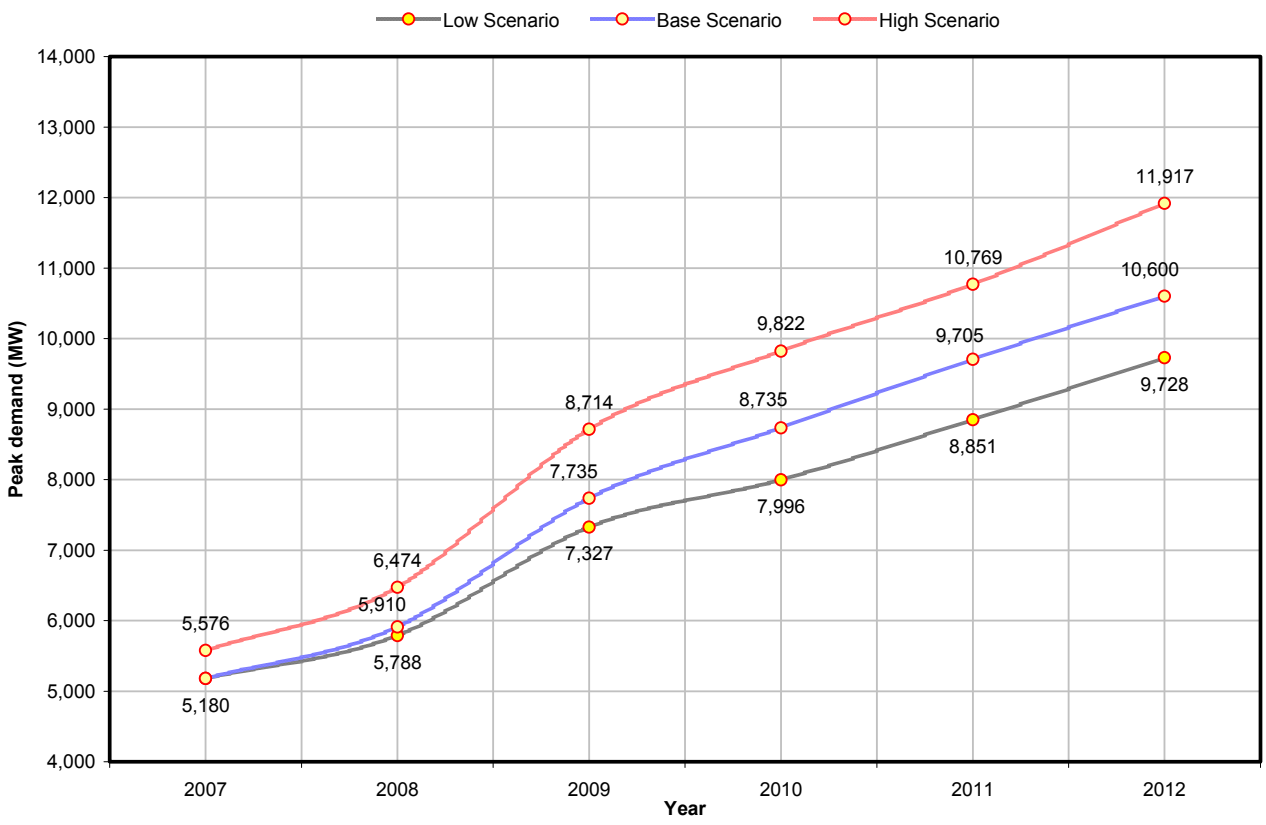


Fig. 3 ADWEC's system peak demand forecast for Abu Dhabi Emirate.

As required by the Bureau, TRANSCO 5-Year Electricity Planning Statement (2008-2012) update is based on the ADWEC's base case peak demand forecast (most probable forecast scenario) for the Abu Dhabi Emirate. The demand requirements of the Mega Projects have significant influence on the updated load forecast model as shown in Figure 4. The peak system demand will be expected to reach about 10,600 MW in the Year 2012. The estimated demand growth (2007-2012) excluding Mega Projects' requirements is 7.6%. For the same planning horizon, the estimated demand growth including Mega Projects is 14.8%.

ADWEC's base case system coincident demand forecast is further disaggregated among the existing and proposed 132/11kV and 220/33kV substations based on the electrical connectivity and geographical dispersion in Abu Dhabi, Al-Ain and Western regions.

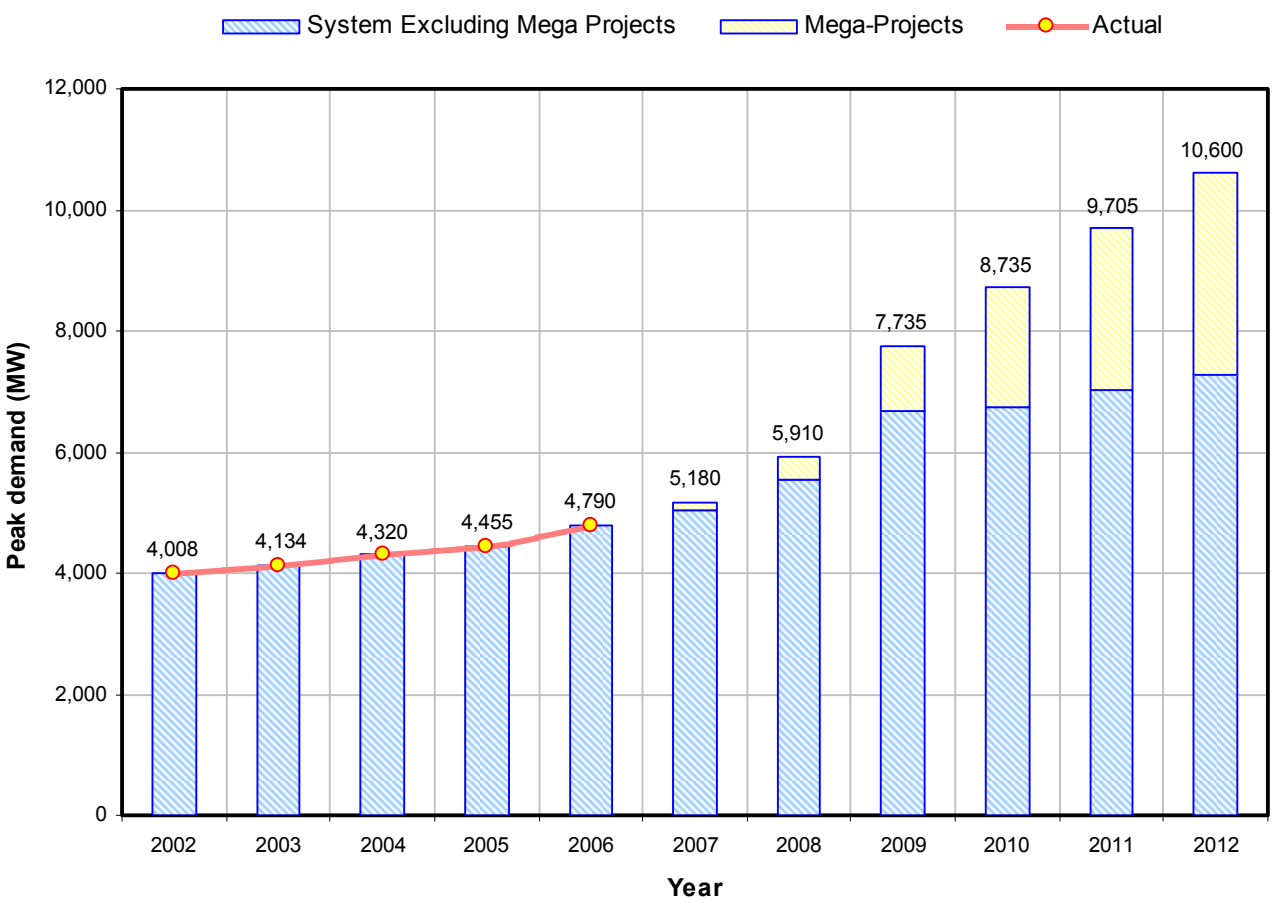


Fig. 4 Influence of Mega Projects on the load forecast model.

The substation wise demand forecast summary at various demand supply points for the Abu Dhabi, Al-Ain, Western Regions and Northern Emirates are shown in the following Tables. The transmission losses are excluded from the sum of area wise forecast shown in the following Table 2 to Table 7 and hence total summation of the system coincident demand forecast will be the slightly less than the overall ADWEC's base case electricity forecast.

Table 2. Sum of Area Wise Electricity Demand Forecast Summary.

Demand Forecast Summary (excludes demand forecast of Northern Emirates)

S.N	Year	2006 (Actual)	2007	2008	2009	2010	2011	2012
A)	**Abudhabi Island & Mainland Region**							
1	Abu Dhabi Island+Mainland+Distribution loss Total-MW	2,408	2,567	2,982	3,611	4,125	4,302	4,472
2	Other Mega Projects+Distribution loss Total-MW		included	included	452	897	1,453	2,024
	Sub-Total (Island+Mainland+Mega+Distribution Losses)-MW	2,408	2,567	2,982	4,063	5,022	5,755	6,496
B)	**Western Region**							
1	Western Region+Distribution Losses Total-MW	352	587	596	1,108	1,143	1,206	1,228
	Sub-Total (Western+Distribution Losses)-MW	352	587	596	1,108	1,143	1,206	1,228
C)	**Al-Ain Region**							
1	Al-Ain Region+Distribution Losses Total-MW	1,384	1,411	1,487	1,580	1,668	1,713	1,783
	Sub-Total (Al-Ain+Distribution Losses)-MW	1,384	1,411	1,487	1,580	1,668	1,713	1,783
D)	**Auxiliary**							
1	Auxiliary in the Mainland/Island (ADWEC data)-MW	515	536	590	676	592	566	566
2	Auxiliary in the Western Region (ADWEC data)-MW	131	161	149	167	147	283	328
	Sub-Total (Auxiliary)-MW	646	697	739	843	739	849	894
	Total-1 (MW)	**4,790**	**5,262**	**5,804**	**7,594**	**8,571**	**9,523**	**10,401**

Demand Forecast Summary (for Northern Emirates)

S.N	Year	2006 (Actual)	2007	2008	2009	2010	2011	2012
1	Fujairah (Al Hayl, Sudah Port and Tawain)			120	300	300	500	500
2	Ras Al Khaimah (RAK City, Khor Khawir and Tawain)			400	400	400	400	500
3	Auxiliary			135	137	343	343	343
	Total-2 (MW)			**655**	**837**	**1,043**	**1,243**	**1,343**

Grand Total (Abu Dhabi, Al-Ain & Northern Emirates) - MW	**4,790**	**5,262**	**6,459**	**8,431**	**9,614**	**10,766**	**11,744**

Note:

Based on discussions with ADWEC in May 2007, the electricity demand forecast for the Northern Emirates' (mainly Fujairah & Ras Al Khaimah) is NON-FIRM and the magnitude of power supply commitment for demands outside the Abu Dhabi Emirate is uncertain. Hence, for the purpose of this 5-Year Planning Statement, the assumed electricity demand forecast for the Northern Emirates is shown above. These were studied by TRANSCO using the available generation capacity margin; however there is a deficit in the required generation capacity margin if Northern Emirates demand is considered per current ADWEC's generation expansion plan up to Year 2012.

Table 3. Abu Dhabi Island - 132/11kV Substation Peak Demand Forecast (MW).

S.N	Substation Name/Code	S/S Capacity (MVA)	S/S Firm Capacity (MW)	2006 (Actual)	2007	2008	2009	2010	2011	2012
1	Market 1-MKT1 (W1)	4 x 40	109	68	76	78	70	72	74	77
2	Market-MRKT (W02)	3 x 40	73	52	52	54				
3	Khalidiya-KLDY (W09)	4 x 40	109	85	91	91	92	95	98	102
4	Al Jazeira Hosp-JZRH (W13)	4 x 40	109	90	90	91	94	96	99	103
5	Bateen-BATN (W16)	4 x 40	109	72	83	84	108	102	102	106
6	Bateen Bus Station-BSTN (W17)	4 x 40	109	74	84	87	90	92	95	99
7	Mushrif -MSRF (W24)	4 x 40	109	98	68	70	72	75	77	80
8	Embassy-EMBS (W59)	4 x 40	109	91	87	90	78	81	83	86
9	Conference Palace (CONH)	4 x 40	109	26	26	26	35	49	61	61
10	Madinat Zayed-MDZD (E04)	4 x 40	109	97	100	102	107	107	107	107
11	Capital Gardens-CPGR (E08)	4 x 40	109	90	97	100	83	86	89	93
12	Firdous-FRDS (E09)	4 x 40	109	72	55	57	58	60	62	65
13	Zayed 2nd St-ZYD2 (E11)	4 x 40	109	90	98	82	85	87	90	94
14	Tourist Club-TCLB (E15)	4 x 40	109	87	95	64	66	68	70	73
15	Al Salam-ALSM (E18)	3 x 40	73	62	51	54	56	58	59	61
16	Higher Tech. College-HTCO (E25)	4 x 40	109	80	85	88	91	93	96	100
17	Beach-BECH (E48)	4 x 40	109	83	57	59	49	51	52	54
18	Falah-FLAH (E18/02)	4 x 40	109	50	55	57	59	60	62	65
19	* ADPS-Old	2 x 80	73	32						
20	* ADST	2 x 120	109	52	85	85	70	72	68	71
21	Marina Mall-MRML	4 x 40	109		28	29	30	31	32	33
22	GLFA (W47)	4 x 40	109		41	53	75	77	80	83
23	Port (E14)	4 x 40	109		22	40	41	43	44	46
24	QURM (E19)	4 x 40	109		30	38	39	41	42	44
25	E16/02	4 x 40	109			38	81	83	86	89
26	E01	4 x 40	109				59	60	62	65
27	W06	4 x 40	109				45	47	48	50
28	Khalifa Park	4 x 40	109				30	31	32	34
29	W41	4 x 40	109				34	58	82	85
30	E40	4 x 40	109				34	59	84	95
			Total (MW)	1,449	1,556	1,617	1,831	1,933	2,036	2,122

* The loads are fed from 132/33kV transformers.

Table 4. Abu Dhabi Mainland-132/11kV & 220/33kV S/S Peak Demand (MW).

S.N	Substation Name/Code	S/S Capacity (MVA)	S/S Firm Capacity (MW)	2006 (Actual)	2007	2008	2009	2010	2011	2012
1	Mussafah (MOS1)-132/11kV	4x40	102	100	100	100	100	100	100	100
2	* Madinat Khaleefa (MDKH)-132/11kV	4x40	102	43	46	62	46	57	61	67
3	Khaleefa A2 -132/11kV (For Raha Gardens)	4x40	102				35	46	49	51
4	Airport (AIRP)-132/11kV	4x40	102	27	38	40	42	50	53	58
5	Salt & Chlorine (SLTC)-132/11kV	3x40	68	48	41	43	48	50	52	57
6	S-18 (132/11kV)	4x40	102		28	33	57	62	67	73
7	Bahya (BHYA)-132/33kV	2x140	119	32	38	80	82	85	87	87
8	Mussafah (MOSG)-220/33kV	3x140	238	275	280	220	220	220	220	220
9	MGIC-220/33kV	3x140	238			80	212	212	212	212
10	ICAD 220/33kV	2x3x100	2x182					262	360	360
11	ICAD Steel Factory (GHC & Emirates Steel)					233	233	233	233	233
12	Mahawi (MHWG)-220/33kV	3x140	238	57	60	68	147	204	158	197
13	Shahama East (SHME)-220/33kV	3x140	238	149	150	150	160	162	163	179
14	Wathba (WATH)-220/33kV	2x100+140	170	190	190	170	170	170	170	170
15	Samha (SMHG)-220/33kV	2x140	119	38	40	42	46	47	50	55
16	** Shamka 220/33kV	3x140	238			44	182	232	232	232
			Total (MW)	959	1,011	1,365	1,780	2,192	2,267	2,350

* The substation capacity at Madinat Khaleefa will be 3x40 MVA (inclusive of mobile unit) in Yr 2007. The mobile 40 MVA unit will be replaced with a new 40 MVA transformer and an additional 4th 40 MVA transformer will be commissioned in Yr 2009.

** 80 MVA mobile unit at Shamka is expected to commission after Summer 2007. New 3 x140MVA transformer capacity will be commissioned in Yr 2009 replacing the mobile unit.

Note:

The 220/33kV substations at Mahawi and Wathba will be converted to 132/33kV substations by Year 2011 after commissioning the proposed new Mahawi 400/132kV (4x500MVA capacity) grid station.

Table 5. Western Region - 220/33kV Substation Peak Demand Forecast (MW).

S.N	Substation Name/Code	S/S Capacity (MVA)	S/S Firm Capacity (MW)	2006 (Actual)	2007	2008	2009	2010	2011	2012
1	Liwa	3x100	170	134	134	134	136	138	142	142
2	Liwa West (Mobile Substation)	1x80	68			6	12	12	12	13
3	Madinat Zayed	2x100+1x140	170	61	63	68	87	99	101	106
4	Sila	2x80	68	22	23	25	26	27	28	30
5	Mirfa	2x100	85	52	56	42	43	44	44	48
6	Ghayathi	2x140	119			15	35	36	38	41
7	Ruwais	2x140	119	49	49	32	35	38	40	44
8	Buhasa	4x140	382		47	47	147	147	172	172
9	Bab (220/132kV)	2x320	291		82	89	197	206	231	231
10	Bab 220kV (GASCO OGD II)				30	30	65	65	65	65
11	Bab 220kV (For Bab Gas Compre)						150	150	150	150
12	ASAB (220/132/33kV)	2x200	182		55	55	115	119	119	119
13	Dabiyah 220/33kV	2x110	94	28	28	28	28	28	28	28
14	Rumaithy 220/33kV	2x50	43	6	6	6	6	6	6	6
15	Central (CNTG)-220/33kV	2x140	119		14	19	26	28	30	33
			Total (MW)	352	587	596	1,108	1,143	1,206	1,228

Table 6. Preliminary Peak Demand Forecast for Other Mega Projects.

Other Mega Projects in Abu Dhabi Region - Peak Demand Forecast (MW)

S.N	Description	2007	2008	2009	2010	2011	2012
1	Al Raha-A				29	40	53
2	Al Raha-B			33	40	60	70
3	Airport Sites			117	130	158	178
4	Yas Island Development			90	140	191	230
5	Mina Zayed				111	111	111
6	Al Reem Island			212	358	528	646
7	Al Sadiyat Island				64	127	216
8	Saraya				25	57	88
9	Mohamed Bin Zayed Area					95	100
10	ICAD III/IV/V					86	332
	Total (MW)			452	897	1,453	2,024

Note: Peak demand forecast of the other Mega Projects shown in Table 6 are in the preliminary stage and are being continuously updated by ADWEC/ADDC.

Table 7. Al Ain Region - 220/33kV Substation Peak Demand Forecast (MW).

S.N	Substation Name /Code	S/S Capacity (MVA)	S/S Firm Capacity (MW)	2006 (Actual)	2007	2008	2009	2010	2011	2012
1	* Sweihan	2x80+140	136	78	78	80	80	81	82	86
2	Al-Hayer	3x80	136	59	59	59	60	62	63	66
3	Al Foah	2x140	116	39	52	55	60	62	63	66
4	** Dahma	3x120	204	69	70	75	88	90	91	97
5	AAPS-Toshiba	2x100	84	72	75	75	76	77	78	82
6	AAPS-Cal Emag	2x80	65	68	46	46	40	40	40	40
7	AAPS-Siemens	2 x80	67	65	57	57	50	50	50	50
8	City Centre	3x140	230	111	115	116	134	139	140	148
9	Mazyad	2x140	123	65	67	88	93	100	101	107
10	Sanaiya	3x140	246	114	116	117	136	144	146	154
11	Zakher	2x140 + 2x90	250	211	177	180	191	205	211	219
12	Al Salamat	3x140	258	74	92	94	103	113	118	120
13	Ramah	3x140	246	106	106	110	114	117	119	126
14	Al Khazna	2x140	123	53	57	58	59	61	62	65
15	Al-Ain South West	4x140	370	21	51	82	103	128	140	144
16	Al-Arad	2x140	106	81	84	84	85	85	90	91
17	Al-Wagon	2x80+140	126	98	110	110	77	79	84	85
18	Umm Al Oush	2x140	123				33	34	36	36
			Total (MW)	1,384	1,411	1,487	1,580	1,668	1,713	1,783

* New 140 MVA transformer at Sweihan will be commissioned in Yr 2008.

** The substation capacity at Dhama is 2 x 80 MVA in Yr 2007. One 140 MVA spare transformer (from Stores) will be commissioned in Yr 2008. The 2 x 80 MVA + 140 MVA transformers will then be replaced with new 3 x 120 MVA transformer capacity that will be commissioned in Yr 2009.

Note: AADC recently advised that there are several large development projects, which are in the preliminary planning stage and these developments are likely to have impact on the electricity demand forecast in the Al-Ain Region from Year 2010 onwards.

3.2 Electricity Capacity Expansion Plan

The ADWEC's Licence Conditions 18.1 and 18.2 requires the Licensee to prepare and publish annually the statement showing the following details relevant for the next seven financial years;

a) Amount and nature of relevant capacity available and expected capacity that will be taken out of service permanently in those years.
b) Amount and nature of relevant capacity it expects it shall require to be available to it in order to ensure that the desalination and generation security planning standards shall be met; and
c) In respect of the first five financial years only, general details of its then current plans for securing that additional relevant capacity shall be so available to it.

The planning criteria for generation expansion is based on loss of load expectation (LOLE) of 1 day in 10 years, and is based on generation forced outage rates of 5% for non-IWPP stations and the PWPA specified rates of 3%-3.5% for IWPP stations. This equates to a reserve margin of around 16% in 2020.

Based on the ADWEC's updated statement of future generation capacity requirement (2007-2012) inclusive Fujairah capacity, the total "available generation capacity" and "required generation capacity" is expected to be around 12,800MW and 12,500MW respectively in Year 2012. The summary of electricity generation capacity and peak demand forecast for the planning horizon 2007-2012 is shown in Figure 5.

Table 8 shows the summary of available generation capacity, required generation capacity, peak demand of Abu Dhabi Emirate & Northern Emirates and estimated demand supply gap and transmission losses for the planning horizon 2007-2012. In view of uncertainty of the Northern Emirates' demand, ADWEC has not included the said demand in their computation of the "required generation capacity".

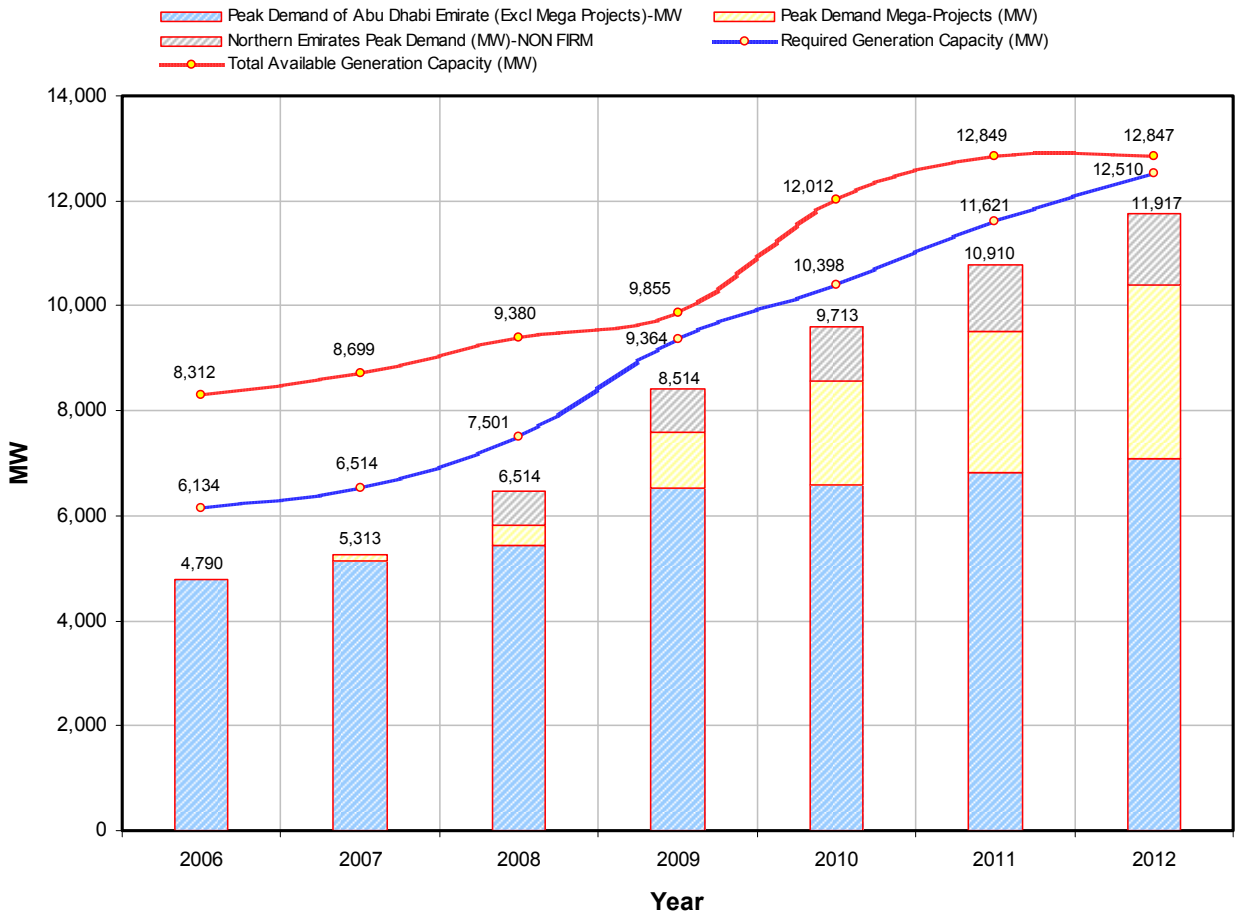


Fig 5. Generation capacity and peak demand forecast for the planning horizon.

Table 8. Demand supply gap for the planning horizon 2007-2012.

S.N	Description	2006	2007	2008	2009	2010	2011	2012
1	Demand Forecast-Abu Dhabi Emirate (MW)	4,790	5,262	5,804	7,594	8,571	9,523	10,401
2	Demand Forecast-Northern Emirates (MW)			655	837	1,043	1,243	1,343
3	Total Demand (MW) #	4,790	5,262	6,459	8,431	9,614	10,766	11,744
4	Tranmission Losses (Output of PSS/E Load Flow Program)-MW		51	55	83	99	144	173
5	Grand Total Peak Demand (MW)	4,790	5,313	6,514	8,514	9,713	10,910	11,917
6	Total Available Gross Capacity including Fujairah (MW)	8,312	8,699	9,380	9,855	12,012	12,849	12,847
7	Required Capacity (ADWEC's Stochastic Output Program)-MW **	6,134	6,514	7,501	9,364	10,398	11,621	12,510
Demand Supply Gap (Required Capacity-Total Peak Demand) - MW		**1,344**	**1,201**	**987**	**850**	**685**	**711**	**593**

includes auxiliary loads as well such as substation & power station auxiliary loads and desalination process plant loads.

** Required capacity takes into account generation planning criteria & other factors such as forced outage rate, demand forecast error, spinning reserve. The required capacity assumes the Northern Emirates demand as non-firm.

The generation capacity plan shown above considers the retirement plans of Abu Dhabi Power Station (ADPS), Al Ain Power Station (AAPS) and Umm Al Nar (Arabian Power Company IWPP).

The major highlights of the retirement plan for Abu Dhabi Power Station (ADPS) and Al Ain Power Station (AAPS) based on ADWEA advice in March 2007 are;

- The immediate plan will be to retire all gas turbine units and condensing steam turbine units ST11 and ST23 at Abu Dhabi Power Station (ADPS) effective from April 01, 2007.
- The immediate plan will be to retire all diesel generator units and gas turbine units GT01-GT06 at Al Ain Power Station (AAPS) effective from April 01, 2007.
- The indicative final plan is the remaining extraction steam turbine units ST12, ST13, ST21 and ST22 (total gross capacity 76MW) at ADPS will retire effective from January 01, 2008.
- The indicative final plan is the remaining gas turbine units GT07-GT16 (total gross capacity 256MW) at AAPS will retire effective from January 01, 2008.

The indicative final plan will be confirmed by ADWEC at the end of Summer 2007 after concluding their generation expansion plan.

Based on the recent discussions with ADWEC, the Umm Al Nar (Arabian Power Company IWPP) site retirement plans are as follows;

- The decommissioning of UAN East B (total gross capacity 130MW) and UAN West 9-10 (total gross capacity 130MW) has been initiated in Yr 2006.
- UAN East A (total gross capacity 118MW), UAN West 1-6 (total gross capacity 360MW), UAN West 7-9 (total gross capacity 300MW) retirement plan will be deferred until after Summer 2010 to allow the completion of new IWPP's at Shuweihat and Fujairah.

Table 9 shows the existing and planned/committed electricity capacity plan (Gross-MW) station wise for the planning horizon.

Table 9. Existing and Planned/Committed Electricity Capacity Plan.

S.N	Power Station	2006	2007	2008	2009	2010	2011	2012
1	Abu Dhabi Power Station (ADPS)	359	76					
2	Al-Ain Power Station (AAPS)	352	256					
Bainounah Power Company (BPC)		711	332					
1	Umm Al Nar East A	118	118	118	118	118		
2	Umm Al Nar East B	130						
3	Umm Al Nar West 1-6	360	360	360	360	360		
4	Umm Al Nar West 7-8	300	300	300	300	300		
5	Umm Al Nar West 9-10	130						
6	UAN-New (SAS NAKEEL)	636	1,666	1,657	1,655	1,652	1,652	1,652
Arabian Power Company (APC)		1,674	2,444	2,435	2,433	2,430	1,652	1,652
1	Al Mirfa Power	186	186	186	186	186	186	186
2	Madinat Zayed	109	109	109	109	109	109	109
Al Mirfa Power Company (AMPC)		295	295	295	295	295	295	295
1	Taweelah B1	878	881	825	825	825	825	825
2	Taweelah B2	350	351	358	358	358	358	358
3	Taweelah B New			1,037	1,037	1,037	1,037	1,037
Taweelah Asia Power Company (TAPCO)		1,228	1,232	2,220	2,220	2,220	2,220	2,220
1	Taweelah A1 (old)	283	283	283	284	284	284	284
2	Taweelah A1 (New)	1,133	1,132	1,131	1,175	1,174	1,174	1,174
3	Taweelah A10				213	213	213	213
Gulf Total Tractebel Power Company (GTTPC)		1,416	1,415	1,414	1,672	1,671	1,671	1,671
Other IWPPs								
Emirates CMS Power Company (ECPC)		762	763	760	759	760	760	758
Shuweihat Power Company (SCIPCO)		1,585	1,577	1,615	1,615	1,615	1,615	1,615
Shuweihat Phase-2							1,615	1,615
Fujairah IWPPs								
SembCorp (Fujairah)		641	641	641	861	861	861	861
Fujairah IWPP						2,160	2,160	2,160
Total Gross Capacity from Fujairah		641	641	641	861	3,021	3,021	3,021
Total Available Gross Capacity (MW)		**8,312**	**8,699**	**9,380**	**9,855**	**12,012**	**12,849**	**12,847**

4 Electricity Transmission System Planning Criteria

The Electricity Transmission System Security Standard, Issue 1, Rev (0) dated March 2005 sets out the criteria and methodology, which TRANSCO shall use in the planning, development, operation and maintenance. The Electricity Transmission Code contains additional criteria and other aspects of quality of supply and therefore shall be read in conjunction with the Security Standards. The Code is subject to regular reviews by the Code Review Panel including the Bureau. The latest update of Electricity Transmission Code (Version 1, Revision 3) was issued in September 2006.

A brief summary of the system planning criteria adopted for the Electricity Transmission System are categorized as below and discussed.

1) General Criteria.
2) Connection Conditions.
3) Generation Connection Criteria.
4) Main Interconnected Transmission System (MITS) Criteria.
5) Demand Connection Criteria.

4.1 General Criteria

TRANSCO jurisdictional requirement and other obligations require the following to be observed:

a) Electricity transmission system shall be planned to comply with N-1 criteria.

b) 400kV system feeding Abu Dhabi Island shall comply N-2 security of supply.

c) Electrical and thermal ratings of the equipment shall NOT be exceeded.

d) Power system shall remain stable with respect to voltage and frequency control under normal and secured outage conditions.

e) Power system shall be developed in an efficient and economical manner.

f) Acceptable safety standard shall be maintained.

4.2 Connection Conditions

TRANSCO and Users (GENCOs, DISCOs and Non-Embedded Customers) connected to the Transmission System have obligations to plan and operate their networks so that minimum performance criteria, set out in the Statutory and Transmission Licence obligations, are met.

Frequency Deviation

The System Frequency of the Transmission System shall be nominal 50Hz with System Frequency set points between 49.95Hz - 50.05Hz and shall be controlled within the limits of 49.9Hz - 50.1Hz unless exceptional circumstances prevail.

Under transient disturbed conditions, System Frequency could rise to 53Hz or fall to 47Hz. However, under disturbed steady-state conditions, System Frequency will NOT exceed 51.5Hz or fall below 48.5Hz.

Voltage Variation

The voltage on the 400kV, 220kV and 132kV parts of the Transmission System at each Connection Site with the User will normally remain within ± 5% of the nominal value. The minimum voltage is -10% and the maximum voltage is +10%, but voltages between +5% and +10% will NOT last longer than 15 minutes unless abnormal conditions prevail.

The voltage on the 33kV and 11kV parts of the Distribution System will normally remain within ± 6% of the nominal value unless abnormal conditions prevail.

Harmonic Distortion

The Compatibility/Planning Levels for harmonic distortion on the Transmission System from all sources under both Planned Outage and fault outage conditions (unless abnormal conditions prevail) shall comply with the levels shown in Appendix-F of the Electricity Transmission Code, Version 1, Rev.3, Sep' 2006.

TRANSCO apply the Planning Levels to the connection of non-linear loads to the Transmission System, which may result in harmonic emission limits being specified in the relevant Connection Agreement.

In summary the Total Harmonic Distortion (THD) for Planning and Compatibility Levels shall NOT exceed the limits shown in the Table 10 below.

Table 10. Planning Levels for Total Harmonic Distortion.

S.N	Description	Total Harmonic Distortion (THD) Level	
		132kV	220kV & 400kV
1	Planning Levels for Harmonic Voltage	3%	3%
2	Harmonic Voltage Compatibility Levels	5%	3.5%

Phase Unbalance

Under Planned Outage conditions, the maximum negative phase sequence component of the phase voltage on the Transmission System should remain below 1% unless abnormal conditions prevail.

Voltage Fluctuations

Voltage fluctuations at a Point of Common Coupling (PCC) with a fluctuating Load directly connected to the Transmission System shall NOT exceed;

- 1% of the voltage level for step changes which may occur repetitively. Any large voltage excursions other than step changes may be allowed up to 3% provided this does NOT constitute a risk to the Transmission System or in TRANSCO's view to the System of any User.
- Flicker Severity (Short Term) of 0.8 Unit and a Flicker Severity (Long Term) of 0.6 Unit, as set out in IEC 61000-3-7 Standard.

Demand Power Factor

Demand power factor shall NOT be less than 0.91 lag at 33kV and 11kV connection points between TRANSCO and Distribution Companies.

4.3 Generation Connection Criteria

The generation connections shall satisfy deterministic criteria comprising the following:

a) Criteria which determine the maximum Normal and Infrequent Infeed Loss Risk for a set of "*Secured Events"*.

For network design and planning purposes the level of these limits are 400MW and 800MW respectively. However, these limits will be reviewed in Year 2008 and expected to be increased to reflect changes of the power network e.g. interconnection with ENG and GCC. The Normal Infeed Loss Risk limit aims to ensure that the system frequency does NOT deviate by more than 0.5Hz for "*Secured Events"* such as bus bar fault outage or single generation circuit outage. However, the *"Infrequent Loss of Power Infeed"* risk aims to avoid deviation of system frequency outside the range 49.5Hz to 50.5Hz for more than 60 seconds.

b) Criteria which determine "*Transmission Capacity"* required avoiding un-acceptable network conditions for a set of "*Secured Events"*.

In either case, prior to any fault or *Secured Events*, the *"Transmission Capacity"* for the connection to the Power Station should be planned such that the following conditions shall NOT prevail;

- Loss of Supply Capacity (valid only for the Secured Event of fault outage except as permitted by the Demand Connection Criteria).
- Primary equipment loading exceeding normal rating.
- Voltage outside the pre-fault planning voltage limits or insufficient voltage performance margins; or
- System instability.

Secured Events could be a fault outage of a single transmission circuit or reactive element, outage of bus bar section or outage of a single transmission circuit with planned outage of another transmission circuit, a Generating Unit or reactive element.

4.4 Main Interconnected Transmission System (MITS) Criteria

The Minimum Transmission Capacity requirements for the Main Interconnected Transmission System (MITS) shall satisfy deterministic criteria and shall be planned such that prior to any fault or *Secured Events*, the following conditions shall NOT prevail;

- Loss of Supply Capacity (valid only for Secured Event of fault outage except as permitted by the Demand Connection Criteria).
- Primary equipment loading exceeding normal rating.
- Voltage outside the pre-fault planning voltage limits or insufficient voltage performance margins; or
- System instability.

Secured Events could be a fault outage of a single transmission circuit or reactive element, outage of bus bar section or outage of double circuit 400kV overhead line/cable feeding Abu Dhabi Island, or outage of any single transmission circuit with planned outage of another transmission circuit, a Generating Unit or reactive element.

4.5 Demand Connection Criteria

The planning of demand connections (132/11 kV substations or 220/33 kV substations) to the Transmission System shall satisfy deterministic criteria and there should be NO loss of supply capacity for the Group Demand following *Secured Events* as illustrated in Table 11.

Table 11. Planning Supply Capacity Following Secured Events

Group Demand (MW)	Initial System Conditions	
	Intact System	With Single Arranged Outage
Over 150MW	Immediately [1] *Group Demand*	Immediately [1] *Maintenance Period Demand*
27MW - 150MW	Immediately [1] *Group Demand*	5 minutes [2] *Maintenance Period Demand*
Up to 27MW	Subject to DISCOs system security criteria	Subject to DISCOs system security criteria

Notes:

[1] A loss of supply not exceeding 5 minutes may be acceptable if this leads to significant economies.

[2] For sites where economies prohibit the provision of a third *Transmission Circuit,* the *Maintenance Group Demand* may be lost for the necessary time to restore outage.

Secured Events could be a fault outage of a single transmission circuit under Intact System; or outage of a single transmission circuit with planned outage of another transmission circuit, a Generating Unit or reactive element.

Maintenance Period is the period of the Year (November to April) during which maintenance of transmission equipment is normally undertaken. Maintenance Period Demand is the demand level experienced at a Demand Supply Point and is the maximum demand level expected during the normal maintenance period. Unless better data are available, this should be 50% of the Group Demand.

5 Electricity Transmission System Expansion Plans

The electricity transmission system is planned to meet the system peak demand forecast for the planning horizon and complying with planning and security criteria. These plans should be consistent with the long-term growth plans for the area and aligned with generation expansion plans.

The 400kV, 200kV & 132kV system development topology for the planning horizon (2007-2012) are attached in the Annexure-A. The indicated network topology and various interconnections takes into account the implementation time scales of the current on-going projects, projects in the tendering stage and the proposed projects (under planning & feasibility study stage) during the planning horizon.

The system performance of the proposed expansion plans are evaluated using PSS/E software showing the expected power flows, fault levels and loading on each part of the transmission system for the next 5 years.

The load flow and short-circuit calculations for the system topology over the planning horizon under peak and off peak conditions for normal and contingency are evaluated. The results of the successful load flow and short-circuit calculations are attached in Annexure-B.

For the short-circuit calculations, the DEWA system is represented by a simplified equivalent model in this 5-Year Planning Statement. The calculated fault levels include 5% margin for 400kV system and 10% margin for 220kV & 132kV system.

Year wise commentary note on the system performance and major projects that will be integrated to the current TRANSCO's transmission system is briefly described below;

5.1 YEAR 2007

The 400kV underground cable circuit between E48-E19 grid stations has already been energized in April 2006. The 2nd 400kV underground cable circuit between E48-E19 and the 400kV underground cable circuits (2 nos) between ADST-E19 are planned to be realized before June 2007. This establishes 400kV ring in Abu Dhabi Island.

The Abu Dhabi Island will be fed by 2 OHL circuits from Taweelah and 2 OHL circuits from SAS Al Nakhel, which will enhance the security of supply standard from N-1 to N-2.

The 400kV OHL circuit is quad conductor, ACSR Dove type rated 1455MVA per circuit. For N-2 contingency (outage of any two combination of 400kV OHL circuit to Abu Dhabi Island), the other two 400kV OHL circuits is capable to meet the Abu Dhabi Island forecast demand and surrounding Islands (REEM & SADIYAT Islands) forecast demand as well up to Year 2010.

The 132kV transmission system in Abu Dhabi Island will be operated as three (3) sub-system zones (E19, E48 & ADST Zones) to ensure the 132kV fault levels are within the switchgear rating, maintain power flow balance and provide operational flexibility. However, because of the restrictions on the short-circuit rating at old 132kV switchgear at ADPS, W2 and W09 and delay in installing NERs; an interim operational arrangement will be adopted by LDC in this Year 2007.

In this year, TRANSCO's 220kV transmission system would be interconnected to ADCO system by establishing new 220kV substations and associated 220kV OHL interconnections at BAB, BUHASA and ASAB in the Western Region.

The 400kV, 220kV & 132kV network topology for Year 2007 are shown in Figure A1 and Figure A7 respectively attached in Annexure-A.

Major projects commissioned or expected to be commissioned before Summer 2007 are the following;

- TAWEELAH-B extension and 400kV OHL interconnection works with the grid.
- 400/220kV grid substation at DAID. 400kV double circuit overhead line between DEWA and DAID 400/220kV grid station.
- 220/33kV substations at BUHASA (4x140MVA substation capacity) and GAITHY (2x140MVA substation capacity) and associated 220kV overhead line interconnection works.
- 220/132kV substations at BAB (2x320MVA) and ASAB (2x200MVA) and associated 220kV overhead line interconnection works.
- 220/33kV substation capacity enhancement from 2x80MVA to 3x80MVA at Al-Hayer. The temporary 80MVA mobile unit at Al-Hayer would then be relocated to LIWA South West.
- 220/33kV substation capacity enhancement to 3x140MVA at Ramah. The earlier substation capacity was 2x50MVA + 80MVA + 140MVA.
- New 132/11kV Substations (4x40MVA) at Marina Mall, W47, E14 and E19.

5.2 YEAR 2008

In this Year, the generation at Abu Dhabi and Al-Ain Power Stations are fully de-commissioned. Taweelah-Bext Power Plant is in operation with gross generation capacity 1,037MW.

The network feeding Fujairah and Ras Al Khaimah in the Northern Emirates will be connected to the ENG network.

The Sweihan 400/220kV grid station is expected to be realized this year which will enhance voltage performance in the Al-Ain region. The existing 400kV OHL circuit between Shahama and Dahma 220/33kV substations will be looped in and out to this grid station. The 220kV OHL interconnections from Sweihan 400/220kV grid

station to 220/33kV substations Al Hayer, Salamat, Ramah and Khazna will be established.

The ICAD steel factory (GHC & Emirates Steel) loads will be fed by a dedicated 220kV switching station connected via three (3) 220kV circuits (from Mussafah, UAN and GIC 220kV bus bars).

The generation and demand schedule for the peak load condition incorporated in the load flow solution are shown in Table 12.

Table 12. Generation and demand schedule for the peak load in Year 2008.

S.N	Description	2008	
		Capacity	Output
1	Umm Al Nar East	778	609
2	UAN-New (SAS NAKHEL)	1,657	1,170
3	Al Mirfa Power	186	100
4	Madinat Zayed	109	
5	Taweelah B1+B2	1,183	900
6	Taweelah B New	1,037	650
7	Taweelah A1 (old+New)	1,414	1,050
8	Taweelah A10		
9	Emirates CMS Power Company (ECPC)	760	480
10	Shuweihat Power Company (SCIPCO)	1,615	1,075
11	Shuweihat Phase-2		
12	Fujairah IWPPs	641	480
	Total (MW)	9,380	6,514

S.N	Description	2008
1	Abu Dhabi Emirate Peak Demand (MW)	5,804
2	Northern Emirates Peak Demand (MW)	655
3	Transmission Losses (MW)	55
	Total (MW)	6,514

Load flow study shows that the system performance (voltage & equipment loading) is satisfactory for the contingency scenario.

The neutral earthing reactors/resistors have been installed at all the 132kV neutrals of 500MVA 400/132kV transformers, to limit the single phase fault currents at 132kV networks to a value closer to the 3-phase fault with an acceptable earthing factor.

Short circuit calculations indicate that the 132kV fault level at Umm Al Nar Power Station (UAN), SAS Al NAKHEL (SAS) and Salt & Chlorine (SLTC) are high (about 38kA). This is due to the old generation at UNPS remains in service. To reduce the fault level, it will be necessary to put the one 500MVA transformer at SAS in open standby mode until all generation at UNPS is retired, if required.

The 400kV, 220kV &132kV network topology for Year 2008 are shown in Figure A2 and Figure A9 respectively attached in Annexure-A.

Major projects expected to be commissioned before Summer 2008 are the following;

- Two 400kV cable circuits between E48-SAS Al NAKHEL grid stations.
- 220kV switching station & associated 220kV cable works for ICAD Steel Factories (GHC & Emirates Steel).
- 400/220kV grid station at SWEIHAN (3x500MVA) and associated 400kV OHL interconnection works.
- 220kV OHL interconnection works between SWEIHAN, AL HAYER & RAMAH/KHAZNA.
- An additional 140MVA transformer capacity addition at SWEIHAN and DAHMA 220/33kV substations. The total capacity at each of the above substations would then be 2x80MVA + 140MVA.

- 400/132kV grid stations at FUJAIRAH & RAS AL KHAIMAH (2x500MVA capacity) and associated 400kV OHL interconnection works with DAID Station.
- 220/33kV substation (3x140MVA capacity) at TAWYEEN and associated 220kV OHL works in Northern Emirates.
- 132/33kV substation (2x140MVA capacity) at KHOR KHWAIR and associated 132kV OHL works in Northern Emirates.
- 220/132kV substation at Shuweihat (2x200MVA capacity) for providing power supply to DELMA ISLAND. 132kV cable interconnection and substation works (132/11kV, 2x40MVA) at DELMA ISLAND.
- Interim supply arrangement at SHAMKA by 220/33kV 80MVA mobile unit.
- New 132/11kV substation (4x40MVA) at E16/02.

5.3 YEAR 2009

In this Year, the generation at Taweelah A Extension (TAW A10) is in operation with gross capacity 255MW.

Two (2) major 400/132kV (4x500MVA) grid stations at REEM and SADIYAT will be commissioned this year to meet the Mega Project demand requirements.

New 400/132kV (4x500MVA) grid stations at BAHIA will be commissioned and connected to 400kV network temporally by looping in and out one circuit of the existing OHL between Taweelah (TAW) and ADST. This new 400/132kV grid station at BAHIA will provide major power supply source to RAHA Developments, new airport site and YAS Island developments.

Two new 132kV cable circuits from the BAHIA 400/132kV grid station will provide the power supply source to the existing 132/33kV substation at BAHIA.

The 132kV OHL between TAW and existing BAHIA 132/33kV primary substation that was feeding from TAW power plant will then became redundant and hence dismantled to use its corridor for establishing a quad circuit 400kV OHL from TAW to BAHIA. A double circuit 400kV OHL shall also be established between BAHIA and SADIYAT grid stations.

The 400kV OHL between Madinat Zayed 400/220kV grid station and Mussafah junction will be commissioned to close the loop of the other outgoing two 400kV OHL circuits from Shuweihat to Madinat Zayed.

New 220/33kV, 2x150MVA transformer capacity at BAB substation and two (2) new 220kV double circuits OHL is proposed to be established between Madinat Zayed 400/220kV grid station and BAB to meet the new demand requirements of the BAB Gas Compression project that is expected to be commissioned in Year 2009. However, the above supply scheme may be subject to detailed investigation after receipt of ADNOC demand requirements and long term plans for the whole region and receipt of confirmation from ADWEC on the generation capacity plans in MIRFA.

The generation and demand schedule for the peak load condition incorporated in the load flow solution are shown in Table 13.

The results of the load flow and short-circuit calculations are satisfactory for the Year 2009 network topology. Short circuit calculations indicate that the 132kV fault level at Umm Al Nar Power Station (UAN), SAS Al NAKHEL (SAS) and Salt & Chlorine (SLTC) exceed switchgear rating. This is due to the old generation at UNPS remains in service. To reduce the fault level, it will be necessary to put the one 500MVA transformer at SAS in open standby mode until all generation at UNPS is retired.

The 400kV, 220kV &132kV network topology for Year 2009 are shown in Figure A3 and Figure A10 respectively attached in Annexure-A.

Table 13. Generation and demand schedule for the peak load in Year 2009.

S.N	Description	2009	
		Capacity	Output
1	Umm Al Nar East	778	695
2	UAN-New (SAS NAKHEL)	1,655	1,450
3	Al Mirfa Power	186	100
4	Madinat Zayed	109	
5	Taweelah B1+B2	1,183	970
6	Taweelah B New	1,037	960
7	Taweelah A1 (old+New)	1,459	1,330
8	Taweelah A10	213	210
9	Emirates CMS Power Company (ECPC)	759	660
10	Shuweihat Power Company (SCIPCO)	1,615	1,439
11	Shuweihat Phase-2		
12	Fujairah IWPPs	861	700
	Total (MW)	9,855	8,514

S.N	Description	2009
1	Abu Dhabi Emirate Peak Demand (MW)	7,594
2	Northern Emirates Peak Demand (MW)	837
3	Transmission Losses (MW)	83
	Total (MW)	8,514

Major projects expected to be commissioned before Summer 2009 are the following;

- 400/132kV grid stations at REEM and SADIYAT (4x500MVA). Part of 400kV cable interconnecting works between REEM, SADIYAT and ADST.
- 400/132kV grid station at BAHIA (4x500MVA)& associated 400kV OHL works.
- Conversion of one 400kV OHL circuit to cable between E48-SAS AL NAKHEL.
- Additional 2x150MVA transformer capacity at BAB and 220kV OHL interconnection works between MADINAT ZAYED-BAB for Gas Compression project (Power supply scheme may change if generation scenario at MIRFA changes).
- 400kV OHL interconnection works between MADINAT ZAYED-Hameem Junction (near the road junction in Mussafah leading to Hameem).
- 220/33kV substation (3x140MVA) at Shamka replacing 80MVA mobile unit.
- 220/33kV substation at DAHMA (3x120MVA) replacing the existing configuration 2x80 MVA + 140MVA.
- Conversion of 220kV overhead lines to cables between 220/33kV substations namely Dhama, Al Ain Power Station, City Centre and Zakher.
- 220/33kV substation at UMM Al Oush (2x140MVA) and associated 220kV OHL interconnection works between Umm Al Oush, ARAD/AL WAGON and Al AIN SOUTH WEST substations.
- New 132/11kV substations (4x40MVA) at E01, W06, Khalifa Park, W41, E40 & Khaleefa A2.

5.4 YEAR 2010

The generation and demand schedule for the peak load condition incorporated in the load flow solution are shown in Table 14.

In this Year, the generation addition at Fujairah will be in operation with gross capacity 2160MW. The 400kV OHL connection between Fujairah to Sweihan grid

stations will be established facilitating export of power from Fujairah Power Plant to Abu Dhabi Emirate.

Table 14. Generation and demand schedule for the peak load in Year 2010.

S.N	Description	2010	
		Capacity	Output
1	Umm Al Nar East	778	765
2	UAN-New (SAS NAKHEL)	1,652	1,440
3	Al Mirfa Power	186	100
4	Madinat Zayed	109	
5	Taweelah B1+B2	1,183	970
6	Taweelah B New	1,037	1,030
7	Taweelah A1 (old+New)	1,458	1,290
8	Taweelah A10	213	210
9	Emirates CMS Power Company (ECPC)	760	660
10	Shuweihat Power Company (SCIPCO)	1,615	1,470
11	Shuweihat Phase-2		
12	Fujairah IWPPs	3,021	1,780
	Total (MW)	12,012	9,715

S.N	Description	2010
1	Abu Dhabi Emirate Peak Demand (MW)	8,573
2	Northern Emirates Peak Demand (MW)	1,043
3	Transmission Losses (MW)	99
	Total (MW)	9,715

New 400/220kV grid station (3x500MVA) and 220/33kV substation (2x3x100MVA) at ICAD and associated 400kV & 220kV OHL works will be commissioned in late 2009.

The 400kV OHL interconnection between Shuweihat and GCC grid is expected to be established.

The quad circuit 400kV OHL between TAW-BAHIA, and the double circuit 400kV OHL between BAHIA-SADIYAT are implemented. The existing 400kV OHL circuit between TAW-Mussafah and TAW-Shahama will be diverted from TAW to TAW B Extension. This is required to enhance the transmission capacity from TAW to Abu Dhabi Island. The 400kV OHL interconnection works between ADST-SADIYAT-BAHIA-TAW B Extension-TAW grid stations involves twenty stages to reach the final configuration. During some of these stages, the system security to Abu Dhabi Island may be reduced from N-2 to N-1.

Load flow study show that the system performance is satisfactory during all load conditions. At low load conditions, some generators are required to be operated in under excitation mode close to unity power factor and within the generators reactive capability curve to supply the required reactive power. There is no over voltage in the transmission system during the low load conditions with all 400kV, 220kV and 132kV network elements in service.

Short circuit calculations indicate that the 220kV fault level at GIC is about 39kA and Mussafah about 41kA. The 132kV fault level at Umm Al Nar Power Station (UAN), SAS Al NAKHEL (SAS) and Salt & Chlorine (SLTC) exceed switchgear rating. This is due to the old generation at UNPS remains in service. Hence, it will be necessary to put the one 500MVA transformer at SAS in open standby mode until all generation at UNPS is retired and/or put the one 500MVA transformer at Mussafah/ICAD in open standby mode to limit the fault levels at the said substations.

The 400kV, 220kV &132kV network topology for Year 2010 are shown in Figure A4 and Figure A11 respectively attached in Annexure-A.

Major projects expected to be commissioned before Summer 2010 are the following;

- Conversion of 2nd 400kV OHL circuit to cable between E48-SAS.
- 400kV OHL modification works between TAWEELAH-BAHIA-ADST.
- 400kV OHL interconnection works between FUJAIRAH-SWEIHAN.
- 400/220kV grid station (3x500MVA capacity) and 220/33kV substation (2x3 x100MVA capacity) at ICAD and associated 400kV & 220kV OHL works.
- 400kV OHL works from SHUWAIHAT to SALWA to establish GCC interconnection.
- 132kV GIS at SUDAH PORT and AL-HAYL, 132kV cable interconnection works and 132/33kV, 3x100MVA transformer capacity in Northern Emirates (The power supply scheme and scope of this project may depend on the final agreed development works for integrating the electricity transmission network of Abu Dhabi Emirate and Northern Emirates).

5.5 YEAR 2011

The generation and demand schedule for the peak load condition incorporated in the load flow solution are shown in Table 15.

The old generation units at UAN power plant are phased out in Year 2011.

The twenty stage 400kV OHL interconnection works between ADST-SADIYAT-BAHIA-TAW B Extension-TAW grid stations are complete and reached the final configuration in this year. The existing 400kV OHL circuit TAW-Shahama has been diverted from TAW to TAW Bext to enhance the transmission capacity from TAW to Abu Dhabi Island.

Load flow study show that the system performance is satisfactory during all load conditions. However, following limitations are observed:

- Over loading of two (2) 400kV cable circuits between REEM-SADIYAT by 10% for tripping of two 400kV cables between ADST-SADIYAT.
- Over loading of two (2) 400kV cable circuits between ADST-SADIYAT by 10% for tripping of two 400kV cables between REEM-SADIYAT.

To alleviate the overloading of the above-mentioned 400kV cables for N-2 contingency, it is recommended to reduce the generation at Taweelah following the outage of the 1st 400kV circuit. However, it should be noted that the study is considered pessimistic as it includes all Northern Emirates demand, which would require higher required generation capacity and consequently should reduce power export from Taweelah to Abu Dhabi.

The 400kV, 220kV &132kV network topology for Year 2011 are shown in Figure A5 and Figure A12 respectively attached in Annexure-A.

Major projects commissioned or expected to be commissioned before Summer 2011 are the following;

- 2nd 400kV cable circuit between ADST-SADIYAT grid stations.
- 400kV OHL modifications work TAWEELAH-BAHIA-SADIYAT.
- 400/132kV grid station (4x500MVA) at MAHAWI.
- 400kV switching station at HAMEEM Junction & related 400kV OHL works.

Table 15. Generation and demand schedule for the peak load in Year 2011.

S.N	Description	2011	
		Capacity	Output
1	Umm Al Nar East		
2	UAN-New (SAS NAKHEL)	1,652	1,420
3	Al Mirfa Power	186	100
4	Madinat Zayed	109	
5	Taweelah B1+B2	1,183	970
6	Taweelah B New	1,037	1,030
7	Taweelah A1 (old+New)	1,458	1,290
8	Taweelah A10	213	210
9	Emirates CMS Power Company (ECPC)	760	662
10	Shuweihat Power Company (SCIPCO)	1,615	1,224
11	Shuweihat Phase-2	1,615	1,224
12	Fujairah IWPPs	3,021	2,780
	Total (MW)	12,849	10,910

S.N	Description	2011
1	Abu Dhabi Emirate Peak Demand (MW)	9,523
2	Northern Emirates Peak Demand (MW)	1,243
3	Transmission Losses (MW)	144
	Total (MW)	10,910

5.6 YEAR 2012

The generation and demand schedule for the peak load condition incorporated in the load flow solution are shown in Table 16.

For the system topology of Year 2012, the load flow study show that the system performance is satisfactory for all load conditions. However, following limitations are observed:

- Over loading of two (2) 400kV cable circuits between REEM-SADIYAT by 15% for tripping of two 400kV cables between ADST-SADIYAT.
- Over loading of two (2) 400kV cable circuits between ADST-SADIYAT by 15% for tripping of two 400kV cables between REEM-SADIYAT.

To alleviate the overloading of the above-mentioned 400kV cables for N-2 contingency, it is recommended to reduce the generation at Taweelah following the outage of the 1st 400kV circuit. However, it should be noted that the study is considered pessimistic as it includes all Northern Emirates demand, which would require higher required generation capacity and consequently should reduce power export from Taweelah to Abu Dhabi.

The results of the short-circuit calculations indicate that the fault level is high at TAW 400kV (~ 60kA), ADST 132kV (~38kA), E-19 132kV (~37kA) after accounting 5% margin for 400kV system and 10% margin for 220kV & 132kV system. Appropriate actions will be proposed to limit the said fault levels within the switchgear ratings.

Table 16. Generation and demand schedule for the peak load in Year 2012.

S.N	Description	2012	
		Capacity	Output
1	Umm Al Nar East		
2	UAN-New (SAS NAKHEL)	1,652	1,550
3	Al Mirfa Power	186	120
4	Madinat Zayed	109	
5	Taweelah B1+B2	1,183	1,010
6	Taweelah B New	1,037	1,010
7	Taweelah A1 (old+New)	1,458	1,405
8	Taweelah A10	213	210
9	Emirates CMS Power Company (ECPC)	758	675
10	Shuweihat Power Company (SCIPCO)	1,615	1,519
11	Shuweihat Phase-2	1,615	1,519
12	Fujairah IWPPs	3,021	2,900
	Total (MW)	12,847	11,918

S.N	Description	2012
1	Abu Dhabi Emirate Peak Demand (MW)	10,402
2	Northern Emirates Peak Demand (MW)	1,343
3	Transmission Losses (MW)	173
	Total (MW)	11,918

The 400kV & 220kV and 132kV network topology for Year 2012 are shown in Figure A6 and Figure A13 respectively attached in Annexure-A.

6 Strategic Plans and Opportunities

6.1 Electricity Transmission System Strategic Plans

TRANSCO's major strategic plans for the development of electricity transmission system for the next five (5) years to meet the electricity forecast demand and generation capacity expansion plans are as follows;

a) The development of 400kV power evacuation facility from the Power Stations is based on realization of ADWEC's generation expansion plan (Taweelah-B Extension in Yr 2007, Fujairah Phase-2 Extension in Yr 2010 and Shuweihat Phase-2 in Yr 2011).

b) The 400kV circuit connections from Taweelah sites are optimized to secure supply to Abu Dhabi Island & Mainland and cater for the demand requirements of the Mega Projects.

c) Realization of 400kV transmission ring to Abu Dhabi Island and hence enhancing the security of supply standard from N-1 to N-2. The 132kV transmission system in Abu Dhabi Island will be accordingly operated as three (3) sub-system zones (E19, E48 & ADST Zones) to ensure the 132kV fault levels are within the switchgear rating, maintain power flow balance and provide operational flexibility.

d) Strengthen the 400kV transmission network in the surrounding regions of the Abu Dhabi Island by integrating the proposed new 400/132kV grid stations (4 x 500MVA capacity) in REEM and SADIYAT to meet the demand requirements of Mega Projects in these Islands.

e) New 400/132kV grid station (4 x 500MVA capacity) in BAHIA and 400kV OHL interconnection works with TAWEELAH and SADIYAT. Power supply to the YAS ISLAND' development, new AIRPORT site and RAHA developments will be fed from this grid station.

f) New 400/132kV grid station (4 x 500MVA capacity) in MAHAWI area to provide strong 400/132kV power supply infeed source to the said area for

securing the existing demand and the upcoming demand requirements of Mega Projects in that area and reconfiguration of selective 400kV & 220kV overhead line network.

g) Proposal to split the 132kV network configuration as three (3) sub-system zones (Umm Al Nar, Bahia and Mahawi) taking into account the new developments in Abu Dhabi Mainland.

h) Provide 400/220kV power supply infeed source in ICAD and adopt phased 220kV development to meet the demand requirements in Mussafah/ICAD industrial area.

i) Reinforce the 220kV interconnection facilities and enhance the substation capacity at BAB to meet the new demand requirements of ADCO.

j) Conversion of 220kV overhead lines to cables between 220/33kV substations namely Dhama, Al Ain Power Station, City Centre and Zakher.

k) Establish 400/220kV grid station (3x500MVA) at Sweihan and connect to Fujairah & Taweelah to facilitate export of power from Fujairah Power Plant to Abu Dhabi Emirate and ensure secure power supply to Al-Ain region.

l) Possible integration TRANSCO's electricity transmission system with that of Northern Emirates offers potential opportunity for the development of electricity transmission system in FUJAIRAH and RAS AL KHAIMAH.

m) Integrate the TRANSCO's 400kV transmission system with GCC Grid through Shuweihat as an interface node to share benefits such as reduced spinning reserve and facilitate future electricity trading among various Utilities in U.A.E and Gulf Region, if required.

n) Phased conversion of remaining 132kV oil filled cables to XLPE.

The major deviations in the strategic plans for the development of electricity transmission system adopted in this 7th 5-Year Electricity Planning Statement compared to the 5th & 6th 5-Year Planning Statement are highlighted in Table 17.

Table 17 Major Deviations in the Electricity Transmission System Strategic Plans (5th, 6th & 7th Five Yr Planning Statements).

S.N	5th Five Yr Planning Statement (2005-2010)	6th Five Yr Planning Statement (2006-2011)	7th Five Yr Planning Statement (2007-2012)
1	The development of 400kV power evacuation facility is based on realization of ADWEC's generation plan [Taweelah-B Extension in Yr 2007 and Shuweihat Phase-2 (2000MW) in Yr 2010].	The development of 400kV power evacuation facility is based on realization of ADWEC's generation plan [Taweelah-B Extension in Yr 2007, Shuweihat Phase-2 (2000MW) in Yr 2010 and Fujairah Phase-2 Extension (1500MW) in Yr 2011].	The development of 400kV power evacuation facility is based on realization of ADWEC's generation plan [Taweelah-B Extension in Yr 2007, Fujairah Phase-2 Extension (2000MW) in Yr 2010 and Shuweihat Phase-2 (1500MW) in Yr 2011].
2	The 400kV power evacuation facility from Taweelah B Extension is connected to Al-Ain and Abu Dhabi Island regions.	The 400kV power evacuation facility from Taweelah B Extension is connected to Abu Dhabi Island & Main land regions to cater for the demand requirements of the Mega Projects. The 400kV power evacuation facility at Taweelah-B Extension has been modified accordingly.	Same as 6th Five Year Planning Statement. However, 400kV OHL connections at Taweelah have been optimized allowing more circuits from existing Taweelah generation to feed Bahia/Abu Dhabi Island.
3	-	Strengthen the 400kV transmission network to meet the demand requirements of Mega Projects in the surrounding Abu Dhabi Islands (e.g. SADIYAT & REEM).	Same as 6th Five Year Planning Statement.

S.N	5th Five Yr Planning Statement (2005-2010)	6th Five Yr Planning Statement (2006-2011)	7th Five Yr Planning Statement (2007-2012)
4	The existing 220kV infrastructure to cater for the demand requirements in ICAD/Mussafah.	Same as 5th Five Year Planning Statement.	Provide 400kV power supply infeed source to ICAD and adopt phased 220kV infrastructure development to meet the demand requirements in ICAD/Mussafah regions.
5	The existing 220kV infrastructure in Mainland to cater for the new demand requirements in MAHAWI and surrounding regions.	Same as 5th Five Year Planning Statement.	Provide strong 400/132kV power supply infeed source to MAHAWI area for catering the demand requirements of Mega Projects in that area & reconfiguration of selective 400kV and 220kV OHL network.
6	-	-	The 132kV network configuration in Abu Dhabi Mainland is proposed to operate as three (3) sub-system zones (Umm Al Nar, Bahia & Mahawi) taking into account the new developments in Abu Dhabi Mainland.

6.2 Generation Opportunities

The generation capacity expansion plans are carried out by ADWEC/ADWEA Privatization Department and all such opportunities are described in ADWEC's draft statement of future generation capacity requirement (2007-2012). The possible opportunities in the generation capacity expansion per ADWEC are briefly summarized below;

- Shuweihat site is the only site that is currently fully prepared and available for future capacity additions (e.g. Shuweihat S3). In the long term, Umm Al Nar and Mirfa may also be considered, but development of additional new site locations by ADWEA is strongly recommended by ADWEC. Alternative sites will need to be developed quickly by ADWEA if the growth in electricity is to be satisfied.

- To achieve maximum fuel flexibility it would be prudent to develop new sites at locations at which different fuels can be delivered, e.g. coal, crude oil and gas. These new sites would also need to be located some distance from urban and environmentally protected areas. In the case of electricity only capacity, new station(s) could be located inland near suitable gas and electricity transmission networks.

- Increased supply of electricity to the oil and gas industries is considered by ADWEC to be a potential long term source of additional demand, over and above the demand identified elsewhere in this Statement, which would in turn necessitate further capacity additions and create more opportunities for investors.

- It is planned that from 2010 onwards that the TRANSCO network will be a key part of the Gulf Cooperation Council (GCC) Grid. ADWEC will then play a pivatol role in the GCC countries from which to trade electricity via the following interconnections :

a) 900 MW between Abu Dhabi and Saudi Arabia (GCC Grid).
b) 1150 MW between Abu Dhabi and Dubai (ENG).
c) 400 MW between Abu Dhabi and Oman (GCC Grid).

The GCC Grid and ENG will therefore present ADWEC with good opportunities for trading electricity with its neighbours.

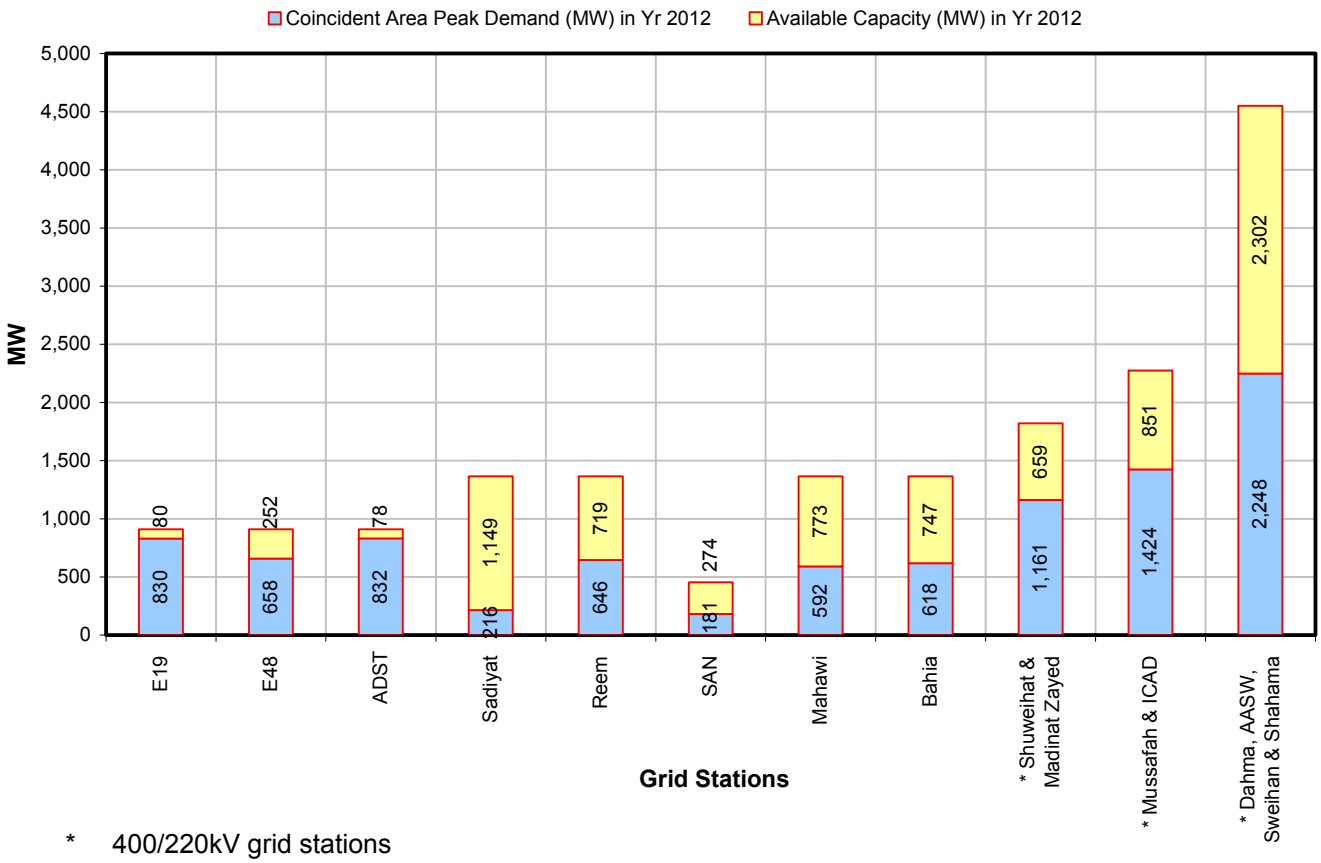
- The Umm Al Nar site could potentially be used to locate some power only capacity, particularly peaking capacity but possibly also combined cycle capacity (i.e. excluding water desalination capacity).

- Renewable technologies, such as solar, are currently under consideration by the Abu Dhabi Future Energy Company via Masdar. Greater use of renewable technologies would likely reduce the scope for traditional IWPP capacity.

6.3 Demand Supply Opportunities

The 400kV electricity transmission system interconnects all major electrical power stations and delivers power supply to various load centres (demand supply points) through 400/220kV and 400/132kV grid stations. All these grid stations are designed to comply with N-1 security of supply standard. These grid stations are grouped based on the transmission network configuration supplying various load centres envisaged by Year 2012.

The availability of transformer capacity (400/220kV or 400/132kV) is assessed taking into account the expected peak demand in Year 2012 and N-1 security criteria, which provides an opportunity to connect potential new loads over and above the demand identified elsewhere in this Statement. Figure 6 shows the available transformer capacity (400/220kV or 400/132kV) in the transmission system for potential demand supply opportunities.



* 400/220kV grid stations

Others are 400/132kV grid stations

Fig. 6 Available transformer capacity (MW) in transmission system in Year 2012.

The potential opportunities for utilization of the spare available transformer capacity beyond Year 2012 in the transmission system is significantly influenced by the ultimate demand requirements of the mega project developments (e.g. Sadiyat and surrounding Abu Dhabi Islands, new airport sites, Raha developments, Al Falah), Mina Zayed Port development, ICAD, ADNOC/ADCO long-term demand requirements in the Western region and other new mega industrial development projects such as aluminum smelter.

7 Metering, Data Exchange and Communication System

Re-structuring and Privatization of the Water and Electricity Sector requires flow of various commodities between various parties to be properly accounted for at boundary points so that financial transactions can be settled.

All the relevant Licensed Operators within the Water and Electricity Sector in Abu Dhabi Emirate have an obligation to ensure that there is a Metering System installed complying with the provisions of Metering & Data Exchange Code (MDEC) as reasonably practicable to the Commercial Boundary at each Licensed Operator site. TRANSCO is the custodian of MDEC and has a license obligation to administer settlement metering systems and data exchange. In addition TRANSCO is obliged to support the settlement process by collecting, verifying and providing to ADWEC all the data required for settlement processes.

ADWEA initiated under Shuwaihat S1 Project the provision of Despatch & Settlement Special Facilities (DSSF) under which TRANSCO would be able to collect, process and manage the data required to support its license obligation with regards to settlement data. TRANSCO took the initiative to establish, on licensed operator behalf, the core of the settlement system stipulated in the Metering and Data Exchange Code in order to enable the operation of the DSSF systems.

The communication and telesystem infrastructure is designed to achieve high speed data transfer and cater for the settlement metering and data exchange development project and handle high demand band-width applications such as water management system, video conferencing and CCTV, and also caters for SCADA, power monitoring system and DSSF systems.

7.1 Metering & Data Exchange System

The Metering and Data Exchange Code (MDEC) establishes the minimum technical, design and operational criteria relating to equipment specification, quantities measured and data collected and exchanged between parties for the

purposes of the financial settlement. Commodities included for measurement within this process are:

- Electricity - between Power Producer and Transmission System Operator and from Transmission System Operator to Distribution Company.
- Water - between Water Producer and Transmission System Operator and from Transmission System Operator to Distribution Company.
- Fuel Oil - between Fuel Oil supplier and Power Producer.
- Gas - between Gas supplier and Power Producer.

MDEC compliance is an obligation for all Sector licensees and the responsibility of TRANSCO to maintain it and audit licensee compliance against it. To meet the obligation, TRANSCO initiated the Settlement Metering and Data Exchange Project (N2095) in Year 2005, which is expected to be completed before Summer 2007.

The overall scope of the project covers provision of a metering system that complies with the requirements of the Metering and Data Exchange Code (MDEC). The metering system will have capability to collect and aggregate the metered data and feed this data to a verification system (DCVS) in order to provide a suitable data output format. “Settlement ready meter data” will then be generated that will establish the amount due and the production of appropriate invoices. The system will include field metering at Defined Metering Points (DMPs) for electricity and water as well as fuel gas and liquid fuel supplies to Generators and Desalinators. The project comprises several discrete project components namely:

a) Supply and installation of electricity meters with compensation for the errors of existing non complaint instrument transformers.
b) Supply and installation of water meters.
c) Supply and installation of gas and liquid fuel meters.
d) Provision of radio and fiber optic telecommunication facilities for the settlement metering and data exchange purpose.
e) Provision of data collection, aggregation, validation, and transfer system along with necessary hardware and software under Despatch and Settlement

Special Facilities project (DSSF) by S1 Shuweihat CMS Power Company (SCIPCO).

Future Plans for Metering & Data Exchange System

After establishing the Metering & Data Exchange infrastructure, TRANSCO will play a pivotal role in the incremental growth of the metering systems within the broad frame work described below;

- Issue of MDEC Version 3.
- Establish and administer a process for the registration of meters installed under Project N2095 or through proposed new projects.
- Initiate and perform sealing of a meters installed under N2095 or future project. Also TRANSCO will maintain and audit ongoing sealing related activities.
- Continue to maintain and operate the DSSF systems.
- Continue to provide communication interface to Metering Equipment to a termination point agreed with the Licensed Operator that enables the reliable transfer of all settlement data to the settlement systems.
- Establish metering related procedures and standards in support of the Code including but not limited to registration, testing and calibration, sealing, loss adjustments, data security, inspection, testing and audit of metering installations and measurement error correction.

7.2 Communication System

The general design of the existing telecommunication network is fiber optic system operating in ring configuration mode. The expansion of the communication system is gradually increasing in parallel to both power and water networks in terms of number of nodes and communication links of different media. The future plans for improving the reliability and quality of the existing communication services are;

- Migration from PDH (Plesiochronous Digital Hierarchy) to SDH

All the new station under construction and future planned stations will incorporate Synchronous Digital Hierarchy (SDH) with its first level as Synchronous Transfer Mode level 1 (STM-1) which gives 155 Mbps bit rate.

- Utilization of STM-16 Technology

Long-term strategic plan will be initiated to study the utilization of high bandwidth transmission network provided by SDH STM-16 technology, which will form future backbone of TRANSCO telecommunication network. Future high bandwidth demand applications as in the new water management system (WMS), video conferencing, and CCTV will be provided. SDH technology opens the door for high speed communication upgrade from STM-1 up to STM-64, which gives transmission rate up to 10 Gbps. Also SDH is the basic technology for the new emerging technology namely dense wave division multiplexing (DWDM).

- Data Radio Communication Network

Data radio communication network is under construction to cater for the Emirate wide scattered water metering points. The same network will cater for the interface points monitoring and control by the water management system.

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