

Successful Completion of the 1320 MW

(Gross) Coal-Fired Power Plant

Iskenderun, Turkey

Rainer Borgmann

Iskenderun Üretim ve Ticaret A.Ş (Isken) /

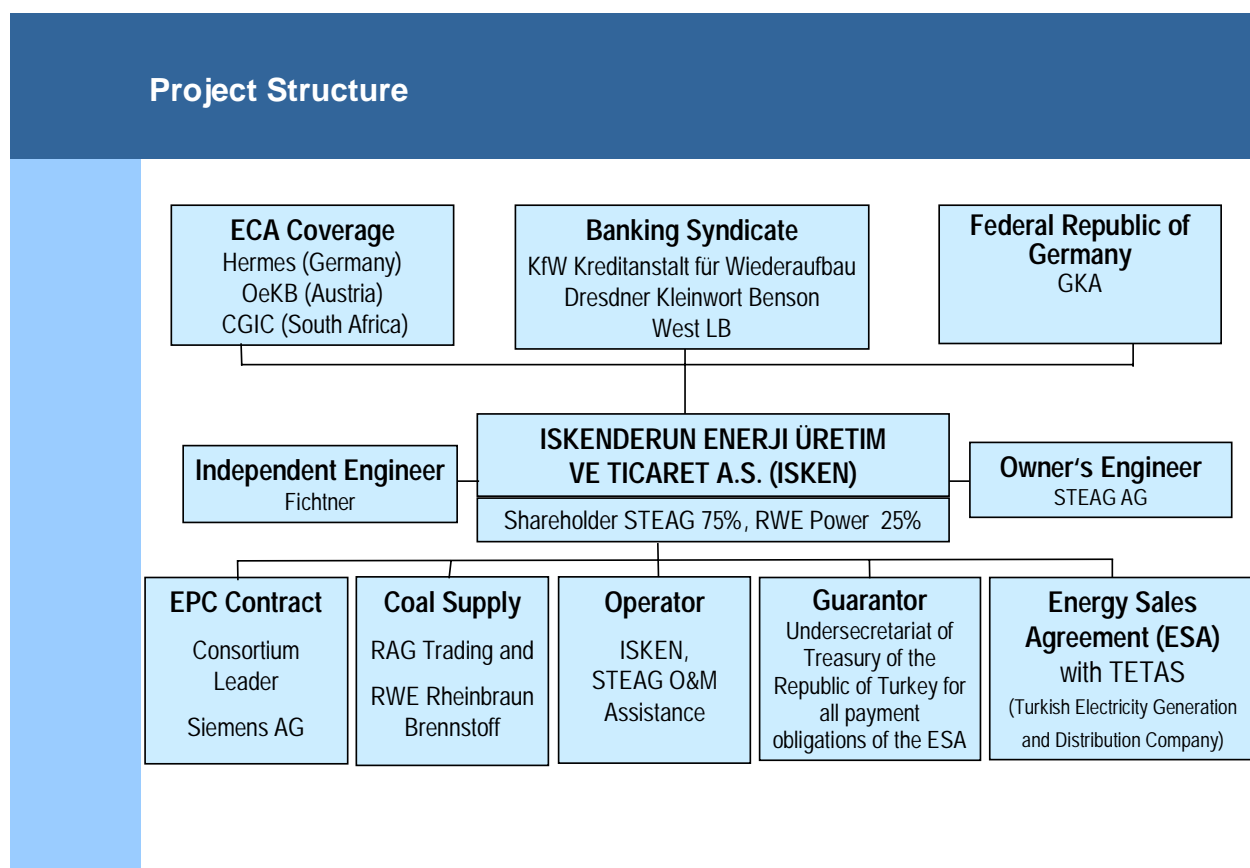
Steag AG, Germany

Rüdiger-Wolf Bentjen

Siemens AG, Power Generation, Germany

- **Project Development**

After three years of project development the 1320 MW (gross) Coal Fired Power Plant Iskenderun achieved financial close on 26 June 2000 as the first of five IPP projects in Turkey which were tendered under the Build Operate scheme.



Steag had financed (together with RWE Power) around one quarter of the 1.5 billion US \$ project from its own resources, 75% had been furnished by a banking syndicate led by KfW, Dresdner Bank and West LB.

The invested capital and the bank loans had been furnished by the respective supplier countries Germany, Austria and South Africa.

On this basis it was possible for Steag to obtain project financing on a non-recourse basis which limits liability of the investors during the construction period to the amount of their own capital contribution.

The investment of 1.5 billion US \$ stands for the biggest German direct investment in Turkey so far.

Financial Structure

ECA coverage from

Hermes	36%
OeKB (Österreichische Kontrollbank AG)	13%
CGIC (Credit Guarantee Insurance Cooperation Ltd)	13%
GKA (Garantie für Kapitalanlagen im Ausland)	38%
Investment Insurance	

Iskenderun Enerji Üretim ve Ticaret A.S. (Isken) was formed to build, own and operate the Power Plant. The basis of the project is a 20 year Energy Sales Agreement (ESA) with TETAS, the government owned Turkish Utility. All payment obligations of TETAS under the ESA are guaranteed by the Undersecretariat of Treasury.

A Coal Supply- and Transport Agreement (CSTA) up to 3.5 million metric tonnes annually was signed between Isken and RAG Trading and RWE Rheinbraun Brennstoff for the entire duration of the ESA. The bituminous coal is procured from the world market mainly from Columbia and South Africa.

Supervision of the EPC Contract was performed by ISKEN with assistance of Steag AG, Fichtner acted on behalf of the lenders as independent engineer for the project.

Client's approach to Project Planning and Execution

After frequent meetings on site up to December 2000, Isken established their site-management in January 2001, the headquarters in Ankara already being in existence. Starting with 4 German STEAG engineers (civil, offshore, mechanical) and in parallel the recruiting of permanent Turkish operational engineers started. Interviews were held all over Turkey and nearly 100 candidates were interviewed for the 13 key staff positions. In August 2001 the Turkish key-staff (1 Human Resources, - 1 Environmental, - 5 Department-Managers and 6

Shift Leaders) were employed and involved in the ongoing site activities. In addition, they took part in a training program performed by the Consortium and by STEAG in its German power plants. The operational staff was employed and trained from January 2002 onwards to be available for the start of the commissioning in early summertime. As required by the erection and commissioning progress, operators and later on maintenance staff were recruited. During the peak commissioning period 17 German engineers and shift leaders from STEAG were continuously on site to monitor the activities and support the Turkish Isken colleagues to fulfil the contractual obligations and develop a power plant organisation.

For the realization of the project, a total of 51 permits had to be obtained, partly with additional sub-permits. One of which was the EIA (Environmental Impact Assessment) as detailed study regarding environmental and social influences during the construction and operation. Apart from frequently analysing sea-, river- and ground-water, as well as air and noise according to a fixed schedule, the support of infrastructure in the surrounding area was demanded.

From the beginning, Isken was focused on positive Public Relations and continuously reported the ongoing activities on site by presentations, invitations to site, newsletters, press articles and interviews. The supporting of social events and improvements to infrastructure (construction of roads, social buildings, bridges and water pipes) was done by Isken from the beginning in order to be in compliance with the EIA requirements.

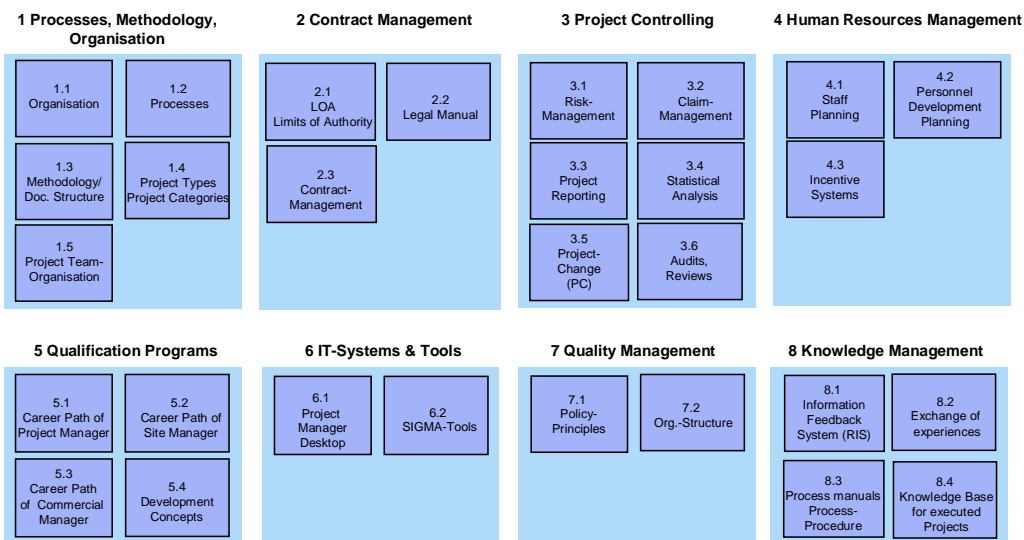
Contractor's approach to Project Planning and Execution

Success of a Project depends essentially on the professional application of Project Management Modules.

These Modules at Siemens Power Generation are the following:

- Processes, Methodology, Organisation
- Contract Management
- Project Controlling
- Human Resources Management
- Qualification Programs
- IT-Systems & Tools
- Quality Management
- Knowledge Management

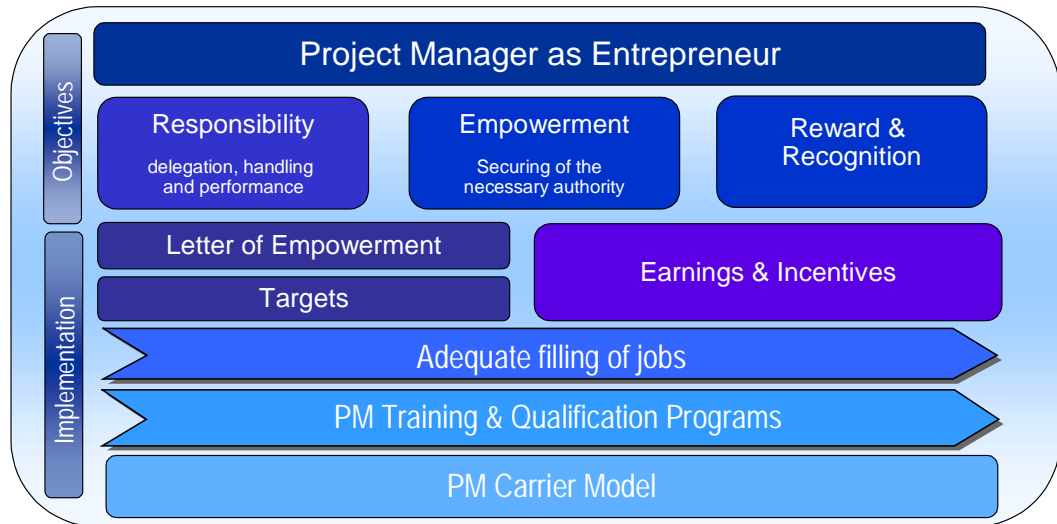
Essential Project Management Modules



The focus of the Project Management is the Project Manager as entrepreneur for the fixed Term entity of a certain project.

He is leading the central project team, consisting of representations from all back offices within the power plant sector, mainly project management, process engineering, plant layout and civil engineering, scheduling and purchasing, etc.

Organisation



The back offices as centres of knowledge in their field provide among others project independent special tasks. The Project execution on site for civil construction, erection and commissioning will be executed by a team as part of the Project Management

Siemens Power Generation internal process manuals describe the tasks and responsibilities of each team member and therefore control the team work. Due to this fact from the early beginning of a project the normal problems associated with interfacing, competence, etc., could be avoided.

The process oriented organisation will be supported by excellent IT-Systems & Tools, such as SIGMA, which guarantee high efficiency and quality.

SIGMA is an integrated software package containing a collection of tools to rationalise project execution from the planning stage through commercial operation.

As normal software products, Excel, Word, etc., support office works, SIGMA supports during project execution both, the technical and business administrative processes.

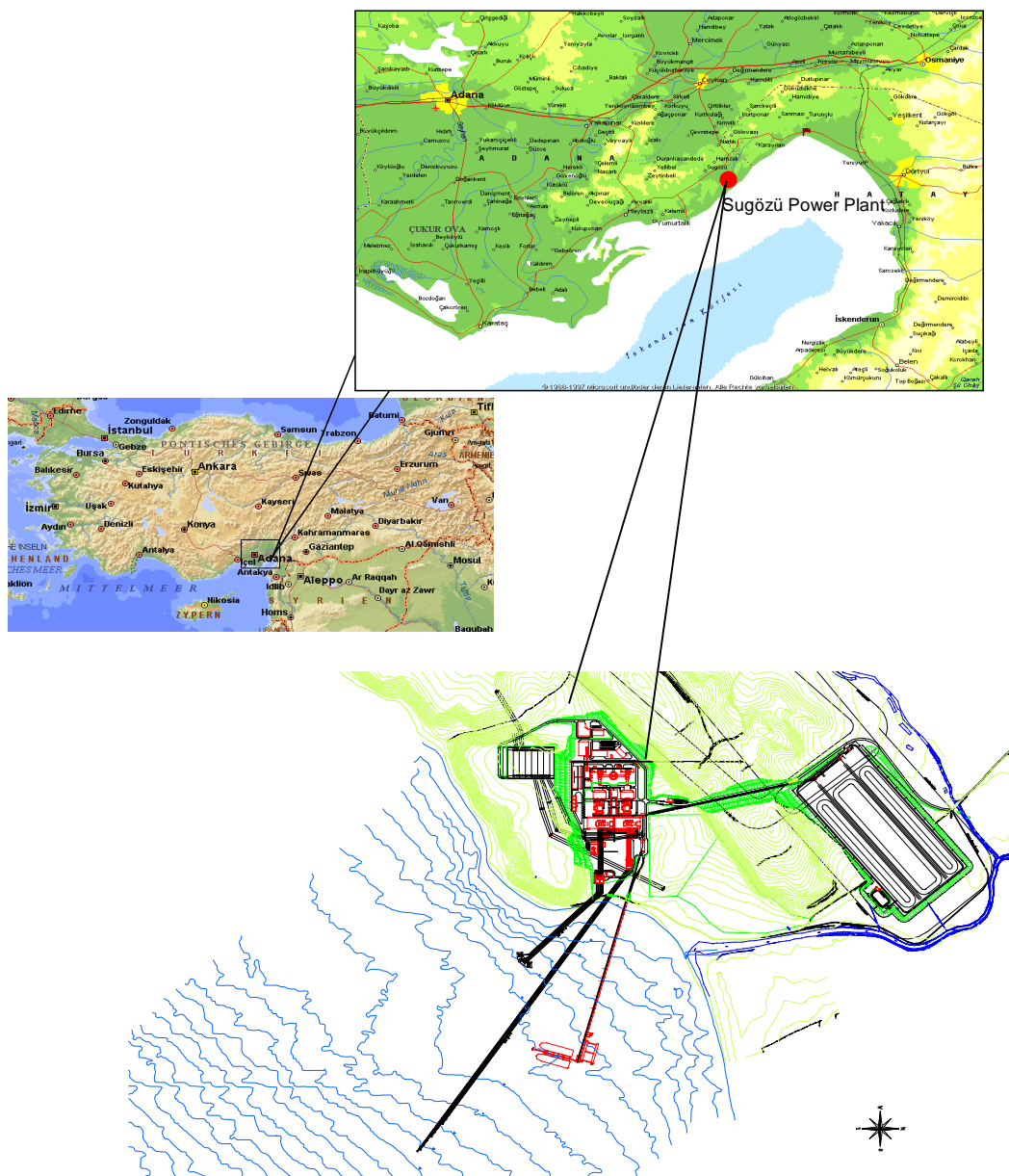
For scheduling as an example PRIMAVERA P3 is used. A coal fired power plant of the 700 MW class consists of approximately 9000 activities and 18 000 logic links to determine the critical path and to identify schedule changes and subsequent impacts. These tools are necessary to support shorter construction periods required by the market.

At it's peak overall planning of the Iskenderun Project involved more than 70 Siemens personnel with engineering hours of approx. 600 000.

- **Construction of the Power Plant**

On 30 June 2000 Isken awarded a fixed price turnkey Engineering, Procurement and Construction Contract (EPC) to an international Consortium led by Siemens Power Generation Group. The EPC Contract comprises a 2 x 605 MW net output coal fired power plant including common facilities. The plant is located in the South East part of Turkey, approx. 80 km away from the fourth largest Turkish city, Adana.

Site Location / Overall Plant Layout



The EPC Consortium formed on 16 June 2000 between Siemens, Babcock Borsig Power and the Joint Venture Gama-Tekfen was jointly and severally liable for the performance of the EPC Contract. Siemens was responsible for the overall plant design, turbo generators, balance of plant, flue gas desulphurisation, coal and ash handling, electrical equipment and instrumentation and control. The Benson steam generator, which was manufactured under Siemens licence including the precipitator was supplied by Babcock Borsig Power while Gama-Tekfen from Turkey carried out the civil works and the major part of the erection. After Babcock Borsig Power's insolvency in July 2002 Siemens took over the complete boiler islands.

The following table shows the main design data and the environmental limits to be complied with in comparison to World Bank and Turkish limits.

Main Design Data

Installed Capacity	2 x 660 MW (MCR, VWO)
Net Power Output	2 x 605 MW
Net Heat Consumption	8,948 kJ / kWh
Live Steam HP Turbine Inlet	524 kg/s, 177 bar, 538 °C
Reheat Steam IP Turbine Inlet	466 kg/s, 49 bar, 538 °C
Condenser 1	23/25.9°C, 39 mbar, 29,506 kg/s
Condenser 2	25.9/29°C, 47 mbar
Generator THDF 115/67	734 MVA / 21 kV / cos phi 0.9

Emission Standards

	Worldbank Limits	Turkish Limits	EPC Contract Guarantees
Particulates	50 mg/Nm ³	150 mg/Nm ³	50 mg/Nm ³
SO ₂	2000 mg/Nm ³	1000 mg/Nm ³	400 mg/Nm ³
NO _x	750 mg/Nm ³	800 mg/Nm ³	650 mg/Nm ³

- **Additional Investment of ISKEN**

Besides the power plant construction by the EPC Consortium Isken had the following additional investments.

- Landfill: For solid waste, mainly ash and gypsum, which cannot be supplied to customers and for hazardous waste from the power plant, an area of 65.000 m² was prepared for a capacity of 1,250,000 m³.
- Overhead lines: 2 x 380 kV OHL, one south-eastward to Erzin 37,5 km
one north-westward to Adana 47,5 km
- Housing area: To accommodate Isken's employees 82 living units incl. shop, restaurant, community hall, sport facilities in a fenced area of 100.000 m² has been constructed in Yumurtalik, 25 km away from the power plant and completed in April 2003.



Housing Area

- **Coal Unloading and Transport Equipment**

Because the bay of Iskenderun is very shallow in front of the power plant, a special solution was required to unload the seagoing coal vessels (Panamax or Capsizer up to 200.000 tons). Therefore the transshipper equipment was realised which consists of the following single units.

- one catamaran with 3 grab cranes on top (30 000 t/day)
- two self unloading barges, each 10 000 tons load capacity.
 - two tug boats
- one service boat
- three single point mooring (SPM-) buoys to keep the transshipper and barges safe during adverse weather conditions



Coal Unloading by Transshipper Equipment



Barge Unloading at the Jetty

- **Schedule Performance**

The works were performed by Siemens in compliance with an integrated time schedule, the following key dates were achieved.

Key Dates			
	Unit 10		Unit 20
Notice to Proceed		30.06.2000	
Ground Breaking Ceremony		04.11.2000	
First concrete pouring		04.12.2000	
Back Energizing	09.09.2002		25.12.2002
Boiler Pressure Test completed	13.09.2002		30.10.2002
First unloading of Coal		24.11.2002	
First Oil Fire	03.12.2002		12.01.2003
Steam Blow	15.01.2003		05.03.2003
First Coal Fire	15.02.2003		13.05.2003
First Steam to Steam Turbine	22.03.2003		07.05.2003
First Synchronising	28.03.2003		09.05.2003
Early Generation Test completed		10.08.2003	
Performance Test completed	03.09.2003		06.09.2003
Reliability Run completed (10 days)		03.10.2003	
60 Days Trial Run including Acceptance Tests completed (Taking over, start commercial operation)		22.11.2003	

During the construction phase the workforce on site amounted to max. 4000 locals and the Siemens site staff including their subcontractors approx. 200 expatriates.

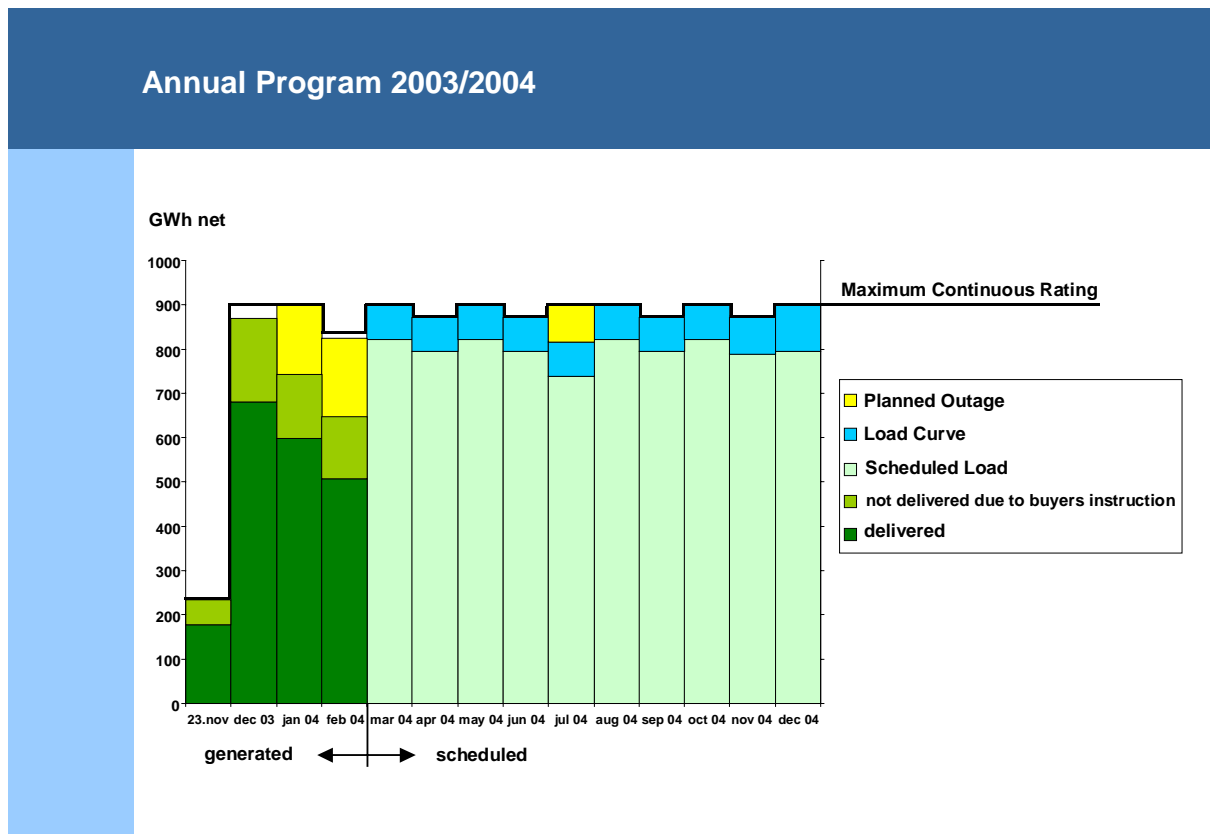
According to the ESA where Early Generation Tests and Acceptance tests were defined these tests had to be witnessed by an acceptance committee appointed by the Ministry of Energy before the 60 days trial run for both Units was released for commencement.

The complete plant was handed over to Isken after the 60 days Trial Run on 22 November 2003 as per EPC Contract which was exactly in compliance with the original schedule issued in June 2000, whereas electricity was provided to the grid according to the load dispatcher of TEIAS after 39 months.

The power plant was ceremoniously opened on 24 February 2004, attended by the German Chancellor and the Turkish Prime Minister.

- **Operational Phase**

The power plant is operated by 250 Turkish employees in accordance with a profile which complies with international benchmarks and applied also by STEAG in their power plants. According to ESA a generation schedule for the upcoming year has to be agreed upon with TEIAS (state owned Generation Department). Therein Isken has to declare the available monthly generation which will be confirmed and nominated by the load dispatch center of TEIAS. The following chart indicates the already generated (2003) and forecasted MW hours. Based on an annual forecast by Isken, the monthly generation is nominated by the NLDC (National Load Dispatch Center). So far up to now the availability agreed with TEIAS was achieved and in some cases even exceeded.

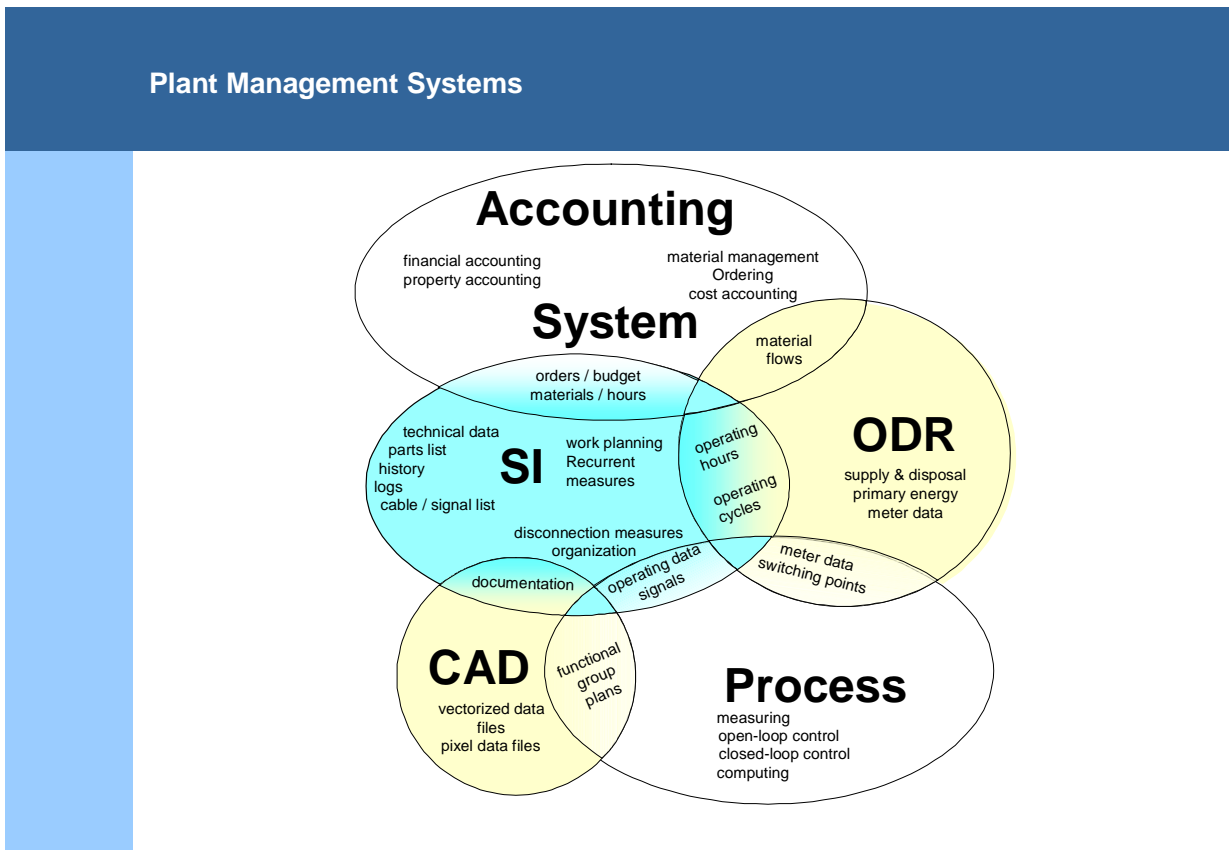


The plant is designed as base load power plant to provide nine billion kWh of electricity on an annual basis which is seven percent of Turkey's energy needs (demand).

In the meantime ISKEN installed a plant management system. The SI System was developed to fulfil the power station specific requirements to manage operation and maintenance.

The main items of the SI System are:

- maintenance budget incl. Orders, manpower, store material
- maintenance scheduling and planning
- archive of components
- shift log
- isolation activities
- staff attendance registration and scheduling



As shown in the chart, there are several links between the SI system and other subsystems to provide the necessary data or documents.



This picture indicates an overview of the Power Station from the north.