



Monitoring and Technical Services (MATS)

**Systems for
Ambient Air, Dust
and Noise**



Systems for Ambient Air, Dust and Noise



The spread of industry into populated areas means that air quality, and especially gas, dust and noise, is increasingly becoming a key issue. Communities need to be assured that the emissions from industrial activities do not affect health or lifestyles. Many industries have had to become more environmentally responsible and aware of possible impacts of their operations on themselves and their neighbours.

Our air quality systems provide environmental managers with the data to properly evaluate circumstances ranging from straightforward complaints to complex environmental impact statements and various other conservation strategies.

ALS designs and supplies a wide range of products for the unattended, long term, continuous monitoring of ambient gas and particle concentrations, stack emissions, noise levels and visibility. Our stations can be fitted with a full range of meteorological sensors and be customised for use with a wide range of third party analysers.

All ALS Measurement and Control Platforms (MCPs), including Water Quality Stations (WQS), Automatic Weather Stations (AWS) and Air Quality Stations (AQS) are designed to be easily integrated into a single, cohesive monitoring network. They are based on quality instrumentation with a proven track record, are versatile and reliable, and are used by government, business and industrial organisations within Australia and around the world.

Measurement of Particulate Matter

Deposition Gauges and High Volume Air Samplers are the most commonly used forms of dust concentration measurements. Particulate monitors use a variety of measurement techniques when continuous and/or real time measurements are required.

Deposition Gauge



Dust deposition gauges are the most effective means of measuring dust deposition at minimal cost. They consist of a glass funnel and filter paper attached to a glass bottle with a rubber stopper. The bottle and filter assembly is placed into a stand so that the funnel is fixed in place and horizontal to the sky. Gauges are left in position for set periods of time (usually monthly) before the bottle and filter is removed and sealed for analysis. At a laboratory, the deposited matter is removed and analysed to obtain the total dust deposited. Deposition gauges cannot provide data with any great resolution (i.e. daily dust concentrations) but they are ideal for long term, remote monitoring due to their low cost and simple design.

High Volume Air Sampler

High Volume Air Samplers (Hi-Vol) are large 240V powered devices with special air intakes designed to remove coarse particles and draw a precise volume of air through a filter paper of known weight for a set period of time. Generally, one sampling period is set for 24 hours, once a week. Filter papers are then removed and taken to a laboratory for weighing, with the mass of dust deposited being the difference between the filter paper start and finish weight. Filter papers can also be ground and analysed for particle types (such as carbon and metals). Different sampling heads can be fitted to the sampler for TSP, PM10 or PM2.5 measurements.



Tapered Element Oscillating Microbalances (TEOM)



The TEOM is a low volume air sampler that incorporates the patented tapered element oscillating microbalance, a unique micro weighing technology that provides true mass measurements. Using a choice of sample inlets, the TEOM can easily be configured to provide continuous PM10, PM2.5, PM1 or TSP concentrations and so are often used in real time dust monitoring networks. The TEOM is not suitable for all applications as it requires a special air-conditioned cabinet, 240V power and installation on a concrete pad.

Beta Gauge



The Beta Gauge type of particle sampler (PM10 or PM2.5) uses a low energy Carbon-14 source to produce a constant source of beta electrons, measured by a Geiger Muller tube or photodiode array. A clean filter tape is placed between the source and the detector and is measured. The tape is then exposed to the air sample before being moved back to the beta source and measured by the beta detector. The difference in beta emissions is proportional to the mass of particles on the tape.

Beta Gauges are EPA compliant, relatively small and lightweight and can be used not only for monitoring of ambient air but also exhaust gas stack emissions.

Grimm Particulate Monitor

The Grimm is a low volume sampler using a light scattering technique to measure the number of particles in the sample. Sample air is drawn past a focused laser beam, with some of the light being scattered by suspended particles in the air sample. This scattered light is detected by a high speed photodiode. The amount of light scattered is used to estimate the dust concentrations in the appropriate EPA categories of PM10, PM2.5 and PM1.

Because of the estimation technique these devices can only be used as a guide, and not to indicate compliance with air quality criteria.



Osiris Particulate Monitor



The Osiris range of particulate monitors can simultaneously record the concentration of airborne TSP, PM10, PM2.5 and PM1 particles. Their operation is based on a pump drawing air through a proprietary nephelometer. Individual particles are analysed as they pass through a laser beam. Size fractions can be determined at concentrations up to several mg/m, with an indicator range above this that can be used without sizing up to 60 mg/m. The particles are then collected on the reference filter, which can be used to confirm the gravimetric calibration of the instrument.

DustTrack Particulate Monitor

The DustTrack desktop and handheld monitors are continuous real time 90° light-scattering laser photometers that simultaneously measure size-segregated mass fraction concentrations corresponding to PM1, PM2.5, PM10, and Total PM size fractions. They combine both particle cloud (total area of scattered light) and single particle detection to achieve mass fraction measurements. This size-segregated mass fraction measurement technique is superior to either basic photometers or optical particle counters.



Measurement of Gas

A wide range of gas detectors, sensors and analysers can be integrated into our data collection platforms.

These devices range from small electronic devices to detect the presence of a single gas, to multi-gas analysers that may use a variety of measurement techniques to meet the specifications of the EPA and other authorities. Gases commonly measured by our systems include:

- Sulphur Dioxide (SO₂), Hydrogen Sulphide (H₂S) and Ozone (O₃)
- Nitrogen Oxides (NO_x, NO and NO₂)
- Carbon Monoxide (CO) and Dioxide (CO₂).

Gas Detectors

Gas detectors are small electronic devices designed to monitor a single type of gas to provide local warning of hazardous levels via visual and/or audible alarms. They may also provide an analogue output (usually 4-20mA) and/or alarm output (contact closure) to a PLC, datalogger or similar device. Gas detectors offer a simple and economical solution for the detection of a wide range of gases with minimal fuss.

Gas Analysers

Gas analysers often output a range of analogue and digital signals to permit not only measurement of the basic gas parameters but also many internal parameters, such as voltages, currents and alarms. They may also feature Ethernet ports and incorporate on-board data logging, and even flash memory for increased data storage.

Most have keyboard/displays for quick access to functions, menus or screens. Automatic calibration of a gas analyser is often possible when integrated with one of our data collection platforms. The station datalogger can be programmed to open and close solenoids to complete the daily self-calibration, thus saving time and on-site labour.



Measurement of Noise and Vibration

A variety of noise measurement solutions are available for integration with our systems. We have successfully installed and commissioned several large noise monitoring networks for customers, ranging from simple omni-directional hand held Sound Level Meters for short or long term deployments through to fully integrated, directional, continuously recording noise monitors.

Sound Level Meters



Modern Sound Level Meters (SLMs) are designed for general sound level measurements, usually as hand held devices for spot or short term deployments. Acoustic filters can provide a large number of results including Leq, Lmax, Lmin, Lpeak, SPL, Leq octaves from L10 to L99, 1/1- and 1/3- octave analysis, plus statistical calculations and many other sound measurements. SLMs that are fitted with RS232 outputs may be connected to and interrogated by our station dataloggers using MODBUS or similar communications protocols.

Directional Noise Monitors

Directional noise monitors are able to deliver accurate noise measurements with direction, informing the user not only of noise levels but from what direction the noise came.

There are only a few practical real time directional noise monitoring systems currently available on the market. One of these is the Sound Science “Barnowl” system that has been successfully implemented at many sites around Australia. This system uses three microphones to produce signals that are evaluated every second by a dedicated computer using special signal analysis software to provide real time noise levels and directions. Barnowls are usually installed in parallel to other data collection systems due to the large amount of data collected.



ALS Air Quality Stations

ALS can design and supply a wide range of Air Quality Stations (AQS) to suit any application, ranging from small hand held systems through to large sophisticated monitoring networks.

The majority of these stations are designed to be fixed and permanent, however portable or mobile stations are also available. They may be customised with virtually any combination of sensors and be fitted with many forms of telemetry system. They may even be configured for multiple applications, such as for meteorological/air quality monitoring networks, or even configured with sensors for hydrological and other applications.

We offer assistance to customers with site selection for ambient air monitoring and assessment against Australian or other relevant Standards, and help with the design and implementation of sampling programmes customised to suit specific requirements.

ALS can supply, install, operate and maintain a wide range of dust, ambient air and meteorological systems suitable for the monitoring and/or control of virtually any environmental parameter, including:

- **Deposition and High Volume Air Samplers**
- **Continuous Low Volume Air Samplers**
- **Gas Analysers, including SO₂, H₂S, O₃, NO_x, CO and CO₂**
- **Continuous Noise measurements, either omni-directional or directional**
- **Wind Speed, Wind Direction, Sigma-Theta, Wind Run and Wind Gust**
- **Air Temperature, Relative Humidity**
- **Solar Radiation, Barometric Pressure**
- **Rainfall**
- **Hydrological.**

All of our stations are completely self-contained with all sensitive components (datalogger, sensor interfaces and telemetry equipment) packaged within a sealed enclosure for protection against the environment.

For smaller systems, and those with weather sensors, the enclosure, sensors and power supply are generally mounted on a custom frame, mast or tower specifically designed for the application and for ease of installation and maintenance. Masts over three meters in height that can pivot, tilt or collapse are preferable to fixed masts or towers due to OH&S issues. Solar or 240Vac power may be used.

For the larger systems (such as a TEOM), the equipment is generally installed in a hut or cabinet (often air conditioned), and mounted on a concrete pad with a dedicated 240Vac power supply.

Sensors are secured using special brackets with all sensor, power and/or communications cabling run, if possible, inside the mast or tower or underground (where possible) for neatness and protection from small birds, animals and the elements.

Measurement Standards

The following table outlines the sampling methods* and analytical

TECHNIQUES FOR AMBIENT AIR MEASUREMENTS

<i>Parameter</i>	<i>Technique</i>
Deposited Matter	Gravimetric Method (AS/NZS 3580.10.1)
Suspended Matter	Integrating Nephelometer (AS 2724.4)
Total Suspended Particulates (TSP) Lead and Other Heavy Metals	High Volume Sampler (AS 2800)
Particulate Matter <10 µm (PM ₁₀)	Size Selective Inlet (AS 3580.9.6)
Particulate matter less than 10 µm (PM ₁₀) and less than 2.5 µm (PM _{2.5})	Tapered Element Oscillating Microbalance (TEOM)
Ozone (O ₃)	Ultraviolet Spectroscopy (AS 3580.6.1)
Nitrogen Oxides (NO, NO ₂ , NO _x)	Chemi-luminescence (AS 3580.5.1)
Sulphur Dioxide (SO ₂)	Pulsed Fluorescent Spectrophotometry (AS 3580.4.1)
Carbon Monoxide (CO)	Infrared Spectrometry (AS 3580.7.1)

* Where applicable, the current Australian Standard methods for ambient air monitoring are described.

techniques used by the EPA and industry in their monitoring programs.

Description

Dust deposited in a dust deposition gauge is analysed in a laboratory. Deposition gauge consists of a 150mm +/-10mm glass funnel attached to a (minimum size) 4L glass bottle with a rubber stopper. The bottle and filter assembly is placed into a stand so that the funnel is 2Mtr +/-0.2Mtr above the ground with the funnel rim horizontal to the sky.

Air, having previously been heated to eliminate any water droplets (fog), is continuously drawn through a sample cell. A beam of light centred on wavelength 530 nm is used to illuminate the air stream. Suspended fine particles in the air cause some of this light to be scattered. A photomultiplier tube, mounted at right angles to the direction of the incident light, produces a signal proportional to the intensity of the scattered light. The method detects particles in the approximate size range 0.1 µm to 2.0 µm.

Sample air is drawn at a flow rate of approximately 1 cubic metre per minute through a glass-fibre filter paper mounted beneath a protective hood to prevent material falling directly onto the paper. Sampling is carried out continuously for 24 hours on a one-day-in-six cycle. Particles in the approximate size range 0.1 µm to 50 µm are collected. Each sample is weighed in a temperature and humidity controlled environment and the mass of the unexposed filter paper subtracted to determine the mass of sample collected. This data, together with the total volume of air drawn in the 24-hour period, yield the concentration (Australian Standard 2724.3). Lead and other heavy metals are determined by chemically digesting the filter paper and the resulting solution analysed for metals using an atomic absorption spectrophotometer.

Samples are collected and weighed for TSP but using a high-volume sampler to which a size-selective inlet (SSI) has been attached. The SSI makes use of the aerodynamics of particles of different sizes to ensure that only those with a diameter less than 10 µm are collected.

The tapered element oscillating microbalance (TEOM) consists of two units. The sensor unit contains the sample inlet (PM10 or PM2.5) and the TEOM microbalance. The microbalance provides the sensitive mass measurement. The control unit houses the processing hardware and flow components. The filter is held on the end of a tapered tube. One end of the tube is free to oscillate while the other end is clamped. As particles land on the filter, the filter mass change is detected as a frequency change in the oscillation of the tube. Combining the mass change with the flow rate through the system provides a measure of the particulate concentration. The instrument computes the total mass accumulation on the filter as well as 30-minute, one-hour and eight-hour averages of the mass concentration. It is therefore capable of providing real time values.

Sample air is drawn into a cell where a beam of ultraviolet light is passed through it to an ultraviolet detector. Some of the light is absorbed by ozone in the sample and is proportional to the number of molecules present. The decrease in intensity between the transmitted light and that of the source is used to determine the ozone concentration in the sample.

Sample air is drawn into a reaction chamber where nitric oxide in the sample reacts with a stream of ozone produced by an ultraviolet lamp in dried air. The reaction produces light in the wavelength range 600 nm to 3000 nm. The light is detected by a photomultiplier tube, the intensity being proportional to the concentration of nitric oxide. The concentration of total nitrogen oxides is measured in a separate sample stream. They are first reduced to nitric oxide using a selective converter and its concentration determined as above. The concentration of nitrogen dioxide reported is assumed to be the difference between total nitrogen oxides and nitric oxide.

A stream of sample air is drawn through a cell where it is exposed to pulsed ultraviolet light, resulting in excitation of sulphur dioxide molecules. These molecules subsequently re-emit light but at a different wavelength; they fluoresce. The intensity of the fluorescent light measured by a photomultiplier tube is proportional to the concentration of sulphur dioxide in the sample air.

Sample air is drawn into a cell where a beam of infrared light is passed through it to a photodetector. Some of the light is absorbed by carbon monoxide in the sample, the amount being proportional to the number of molecules present. By comparing the light intensity received by the photodetector through the sample cell with that received through a similar cell containing reference gas, the concentration of carbon monoxide may be determined.

Temporary and Stand Alone Installations

Air Quality sensors, such as dust deposition gauges, Hi-Vol samplers and many analysers, are designed to be used primarily as stand alone devices (that is, not as part of an integrated monitoring network). In these cases, or when the device is to be used for short term monitoring, they are best deployed as per the manufacturer's recommendations. Generally, Air Quality sensors are available with a wide range of accessories and so may be supplied complete with all necessary enclosures, power supplies, masts and brackets. Most analysers have internal datalogging and so can be set up, monitored and data retrieved using software and cables supplied with the instrument. Manufacturer's software usually supports one or more forms of telemetry for remote data processing and analysis, or this may be accomplished using specialist third party software products, such as HYDSTRA.

Permanent Integrated Installations



Most of our Air Quality Stations and installations are designed to take measurements based on one or more of the previously mentioned standards. When supplied as part of an integrated ALS system, they are generally supplied with huts, enclosures, masts, tripods, towers and brackets customised for the particular application. Most systems are installed on a concrete pad and they will often also require a 240Vac power supply and/or security fencing. Generally these installations are separate to other monitoring equipment, though they may be co-located and integrated with other systems if needed.



System Operation

The dataloggers fitted to each station are programmed to read the various sensors at regular intervals. The results of these measurements are termed the current or 'real time' data. The datalogger then collects or 'logs' these measurements in internal memory at set intervals. This is termed the 'logged data' and is generally the data used for historical purposes. The main difference between the two data types is that real time data is replaced every time a new measurement is taken, whereas logged data is stored and may be retrieved at a later date.

The rate at which the air quality sensors are read and logged by the datalogger is determined by the programmer and the client's requirements. Parameters may be read and logged at the same rate and/or at any interval desired (i.e. 10 second sensor readings and 15 minute, hourly and daily logging). Event or conditional based logging is also possible to collect, for example, instantaneous maximums or wind gust data. Changing these rates at a later date is relatively straightforward. The advantages of logging data on site is that if the telemetry system fails for any reason, the historical data will not be 'lost'.

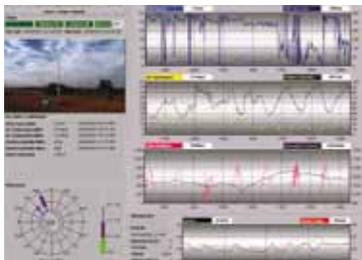
Telemetry Systems

The availability of multiple telecommunications and on-site options for retrieving data allows systems to be customised to meet exact needs. Off-the-shelf telecommunications options include satellite (DCP), radio, telephone, mobile phone, and voice-synthesised phone. Data from stations may be collected by base station software at regular intervals. Data may also be collected on demand if required. In the case of a radio system, the base station computer needs to be located in a suitable area with near line-of-sight communications to the monitoring stations.

Monitoring and Control

Base station computers are typically set up with special software (such as Campbell Scientific LoggerNet software) for the automatic collection and storage of real time and historical data. The data is generally collected in CSV format and can be placed in any suitable location on the customer's computer network. Depending on the telemetry system fitted, systems can be programmed to send alarms or report site conditions by calling out to computers, phones, radios or pagers. Stations can also be polled directly using LoggerNet SDK, MODBUS, DNP3 and other protocols.

Real time or historical data can be displayed or processed with a variety of software. Data exchange between LoggerNet and other SCADA packages can be achieved using OPC. Data can also be exported as ASCII files for further processing by spreadsheets, databases or analysis programs. Real Time Monitoring & Control (RTMC) software can be used to generate displays for monitoring and control by local users. These displays can be published to the intranet/internet using RTMC Web Server software as shown in the examples below.



Data Archiving and Reporting

There are many third party software packages available to process, archive and/or report on the data collected from our Data Collection Platforms.

Vista Data Vision software can be supplied so that customers may carry out data processing, reporting and even web page generation themselves. HYDSTRA Data Management software can be set up to carry out a high degree of automated data processing and reporting, with data being available to the customer via a secure web site. Email and/or SMS alarms can be generated for virtually any condition, including out of tolerance parameters or sensor malfunction.

Applications

Industry



The spread of industry into populated areas means environmental dust and noise is increasingly becoming a key issue. Communities need to be assured that the emissions from these activities will not affect health or lifestyles. Industry must become more environmentally responsible and aware of possible impacts of their operations on themselves and their neighbours. Our AQS provide environmental managers with the data to properly evaluate noise and dust impact in circumstances ranging from straightforward complaints to complex environmental impact statements and various other conservation strategies.

Mining

Mining activities expose large quantities of earth and raw material, such as stockpiles, haul roads, access roads and earthworks, which are all potential sources of dust and particulate matter. Movements of large mining vehicles, blasting and other activities all generate noise that can impact the health and wellbeing of mining workers and surrounding communities. Effective monitoring of the local environmental conditions is a vital component of mining operations. Our AQS (and AWS) can provide managers with all the necessary dust, noise, air quality, wind speed, wind direction and air temperature data. They are easily integrated with Water and Automatic Weather Stations to provide a total monitoring solution for mine environmental managers.



Energy Generation



Energy companies, especially those engaged in power generation using nuclear, coal and geothermal technologies, must meet stringent industry standards. Our stations can be used to obtain complex three dimensional wind speed and direction data for airflow modelling over and around complex shapes and the surrounding area. They are compatible with many third-party gas analysers and Continuous Emission Monitoring (CEM) sensors such as flow rate, opacity, temperature and pressure, and can be used to monitor the efficiency of pollution abatement systems.

Air Quality Index and Pollutant Monitoring

Our stations are ideal for air quality monitoring networks for organisations carrying out routine monitoring for air quality/pollutant inventories and indexes or to obtain general background data. Most cities around the world are required to monitor pollutant levels and environmental parameters in and around their jurisdictions. Stations can be located around the city at critical locations and interrogated by a central computer/server, with the data being made available in near real time for use by environmental officers or placed on the internet for access by the general public. Our systems permit the monitoring of both real time and historical, air quality, pollutant and meteorological data in a logical, unified and organised manner. Data can be displayed numerically and/or graphically, and be used to generate warnings (SMS and email messages) or control warning lights or sirens.



Compliance Monitoring



Many monitoring systems today are used to ensure compliance with government and environmental regulations. Our Air Quality Stations can provide data to monitor and aid in the operation and compliance of smelters, refineries, tailings, landfills, remediation projects, hazardous waste and construction sites, manufacturing and processing plants. Meteorological, dust and noise measurements can be made using a variety of techniques so as to meet the guidelines set down by the EPA and other regulatory authorities. ALS AQS provide data that is scientifically valid, of known precision and accuracy, and is legally defensible.

Dispersion Modelling

Dispersion modelling is the mathematical combination of information from many different sources to simulate or predict how pollutants will be dispersed into the atmosphere. This information is especially important when estimating the potential for pollutant concentration downwind of sources such as industries, factories or highway traffic. Our AQS are able to provide traceable weather and air quality data for these studies for TSP, PM10, PM2.5 and PM1 characterisation.



Ports and Coal Handling Facilities



Traditionally, dust monitoring at coal handling facilities has been achieved using dust deposition gauges or stand alone monitors. A major disadvantage of these systems is that data is up to date only occasionally. With environmental management becoming increasingly important, it is vital that monitoring systems can provide near real time information to support the operational and environmental objectives.

Our Air Quality Systems can be integrated into a single network to deliver weather, dust, noise and water quality data directly into the customer's SCADA system for process monitoring. It may be configured to allow automated process control (such as dust suppression systems) and provide license compliance data to environmental managers and even a community access website.

Residential and Indoor Air Quality

Significant quantities of pollution are released during industrial fires and residential activities, such as space and water heating, wood heaters, backyard incinerators, lawn mowers and emissions from paint, cleaning fluids and other solvents. Wood heaters and fireplaces can contribute more than 50% of the total dispersed pollutants. An emerging issue is the amount of time people spend indoors and the corresponding increase in health and environment issues caused by poor indoor air quality. Although studies into these issues is in its infancy, our Air Quality Sensors and systems are perfectly suited for measurements in these areas.



Benefits of ALS Measurement and Control Platforms

There are many advantages to using our Measurement and Control Platforms:

- They form a common network of stations to collect quality, reliable, environmental data
- May be customised by choosing the number of channels, sensors and communication method required
- Multiple channel types accurately measure nearly every available sensor, including those with analogue, pulse or digital signals (including MODBUS and SDI-12)
- All stations are designed to be as low powered as possible. Power supplies are selected to suit the location and application. Systems may be solar, mains, wind or micro-hydro powered (or any combination). In most cases, a Sealed Lead Acid (SLA) battery is installed to ensure continuous station operation and 100% data recovery even during power blackouts
- Mathematical and statistical calculations can be programmed into the station to provide continuous information on any derived parameters (e.g. stream flow or dam volume)
- Data recording (logging) rate is programmed to suit the site characteristics and client requirements. Time-stamped data recording is fully programmable and may be determined according to time or event (or both). Data is stored directly in engineering units (no scaling required). On board data compression techniques minimise the amount of data required for transmission by telemetry. After telemetry outages, any data not collected is automatically recovered from the station datalogger
- Virtually any communication device may be employed including land line, short haul, cellular, radio (VHF, UHF, Spread Spectrum), satellite, fibre or TCP/IP
- The powerful programming permits automatic decisions to be made based on time or events. For example, if a measurement exceeds a preset threshold, the station can start pumps, open valves, trigger water samplers or send SMS or email alarms. Data is typically displayed and stored in the desired units of measure (e.g., cfs, psi, feet, inches, meters, centimetres)
- The capacity to upgrade and expand the systems is virtually endless. Sensors can be added to sites and new sites can be added to networks at any time. Level monitoring stations can be reconfigured into full water quality stations with minimal effort.

Operation and Maintenance

ALS can provide advice and/or offer servicing and maintenance for all monitoring stations and networks. Please contact ALS for further information.

Other Products and Services

ALS can supply a vast range of related products and services, including:

- Systems for Meteorology, including Automatic Weather Stations (AWS), Rainfall Stations, Evaporation Stations and Lightning Detection and Warning Stations
- Systems for Hydrology, including Water Quality Stations (WQS), Gauging Stations, Rainfall Stations, Flowmeter Stations and Flood Warning Stations
- Systems for Agriculture and Aquaculture
- Systems for Civil, Industrial and Geotechnical Engineering
- Dataloggers, Data Acquisition, Sensing and Telemetry Equipment
- Power Supplies, Huts, Enclosures, Masts and Mounting Brackets
- Data Monitoring, Control, Collection and Processing Software, including data hosting and web access
- System Design, Installation, Commissioning, Operation, Maintenance
- Training, Documentation and Quality Control.

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