*Part II of a Two-Part Series*

# Incorporating International Environmental Legislation Into Power Plant Development

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*Editor's Note:*. Part I, which appeared in the Summer 1997 issue of *Cogeneration and Competitive Power Journal,* reviewed these aspects of global environmental legislation affecting power plant development: "Economics, Energy and the Environment."... "Environmental Overview of Power Plant Projects."... "Environmental Impact Issues."... and "The Regulators."

Part II concludes the article with reports on "Environmental Standards."... "Meeting Environmental Requirements."... Obtaining Environmental Permits."... and "Trends."

We would like to thank Dr. Cooper for his contribution in bringing a deeper understanding of a complex and all-important subject to the readers of this journal. His experience is in global demand; his article will have equally broad-reaching benefits.

## ENVIRONMENTAL STANDARDS

### Air Standards

The harmful effects of air pollutants are determined by their concentration in the atmosphere and the duration of exposure. Concentrations are usually expressed as "Parts Per Million by Volume (ppmv) or by weight per unit volume (micrograms per cubic meter—

$\mu g/m^3$). The effects of common pollutants on human health have been thoroughly studied and documented. Results of many studies have delineated the maximum allowable concentrations of various pollutants that will not adversely affect health. *Standards* are concentration levels of air pollutants below which significant harmful effects are not encountered. These are incorporated into *Primary Air Quality Standards* that protect human life, and *Secondary Air Quality Standards* that protect wildlife, streams, rivers and forests.

Countries may develop new guidelines for their ambient air quality standards or may use levels previously established by others, such as those of the USEPA, the World Health Organization, or the European Union. Large differences do exist between the numerical standards adopted by various countries and organizations (17).

*The World Bank*

The World Bank is the entity that has by far the largest influence on the environmental programs of the countries in transition and the newly emerging economies. These include the countries where demand for new electric generating capacity is greatest. The World Bank's approach to environmental protection is widely used as the model by other multilateral agencies and by the financial community. Its impact cannot be overstated.

The World Bank is a multilateral development institution whose goal is to assist its developing member countries grow economically and socially to improve their quality of life. The World Bank includes several legally and financially different entities:

- The International Bank for Reconstruction and Development (IBRD)
- The International Development Association (IDA).
- International Finance Corporation (IFC)

These first two institutions have three related functions: lending funds, providing economic and technical advice, and serving as a catalyst to encourage other investors. The IBRD borrows from world capital markets to finance its loans. IDA assists the poorest countries from resources contributed by its wealthier members. The IFC solic-

its foreign and domestic capital to invest, in tandem with its own funds, in the private sector of developing countries.

The Multilateral Investment Guarantee Agency (MIGA), also affiliated with the World Bank, stimulates direct foreign investment in developing countries by protecting investors from noncommercial risk such as war or repatriation.

The World Bank has a strong Environment Department that proactively considers the environmental component in its assessment of potential projects (17, 18, 19, 20, 21, 22, 23).

> *"The Bank requires that new projects [50 megawatts and larger] meet the emission numbers contained in the sector specific guidelines unless the site-specific environmental analysis, which the Bank requires... provides a justification for a variance.... Normal Bank procedures for analysis of industrial projects includes (a) an appropriate environmental assessment... Depending on the circumstances, these site specific requirements will be as strict as or stricter than those set out in the handbook." (24).*

An environmental specialist categorizes projects by a process called environmental screening, to determine the extent of environmental analysis required to support project development. The categories are as follows.

Category A Diverse and significant potential environmental impact requiring an environmental assessment

Category B Significant potential environmental impact which can be readily identified and quantified and for which remedial measures can be prescribed without much difficulty

Category C Insignificant potential environmental impact not requiring an environmental assessment

An *environmental assessment is* an extensive examination of a project's environmental impacts in order to determine their significance. *Environmental assessments* are completed for projects in Category A and partial analyses are completed for projects in category B of the screening process. Before an *environmental assessment* begins, a scoping session is usually held in order to identify specific environ-

mental issues which may impact the project. Scoping frequently initiates the public participation process.

If a proposed location has existing structures or ongoing operations an *environmental audit* of the site should be conducted to determine environmental concerns and liabilities associated with past and present activities, and their implications for property transfer. This audit would be part of the *environmental assessment* for the project and might indicate a need to study the site in greater detail. This *environmental audit* normally occurs after the project has passed an initial review.

Environmental investigations determine which factors should be incorporated into the project design. A common example might be that certain emissions are too high, so pollution control equipment with higher than normal efficiencies must be installed to reduce emissions to an acceptable level.

It is virtually certain that thermal and hydroelectric power projects will fall under Category A if they are large or category B if they are moderate. For these, the World Bank's new *Industrial Pollution Prevention and Abatement Handbook* (23) is quite specific; requirements are stringent. For example,

*"A comprehensive monitoring and reporting system is required."*

The composition and thermal discharge requirements for water effluent discharges are equal to or even more stringent than those currently imposed in many regions of the United States. With respect to air quality, the World Bank requirements for air emissions are also equal to or even more stringent than many of those currently imposed in the United States. For example, an extensive amount of base-line air quality data is required.

The World Bank is currently updating its *Industry Sector Guidelines* (24). It has specific emissions *recommendations* which must be *considered* in all projects they review. Theoretically and in practice, the *recommendations* need not be strictly met. However if they are in fact met, no further analysis or extensive documentation is necessary, and the review will be quicker and simpler. If they are not met, a rather detailed justification must be provided.

A full *environmental assessment* must be completed before a design basis covering emissions of air pollutants for a new power plant

is set. The assessment should establish baseline concentrations of $PM_{10}$, $SO_x$, $NO_x$ and ozone without emissions from the proposed project, and identify the main sources contributing to the total emissions of these pollutants within a defined airshed encompassing the project.

An appropriate dispersion model must then be used to investigate the impact of the proposed project on the ambient concentrations of pollutants under alternative assumptions about environmental controls. If there is any likelihood that the plant will be expanded in the medium or longer term, modeling must also be done for the impacts both immediately and after any probable expansion. Finally, the costs of installing alternative emission controls should be compared with the costs of other measures designed to reduce pollution exposures. If there are significant concerns about the long range transport of acid rain pollutants, this analysis should be extended to identify least-cost options for reducing total emissions from a region or country as appropriate.

The specified *recommendations* listed below represent basic minimum guidelines that apply to all projects. More stringent requirements would be imposed if the environmental assessment indicates that the adverse environmental impacts outweigh the additional costs involved, although no quantitative criteria are presented. As an example, if the *environmental assessment* establishes for one or more pollutants that a) the baseline exposure of the population in the airshed exceeds the trigger value for ambient exposure specified in the relevant pollutant guidelines and b) the project will worsen citizen exposure levels, then the government and the World Bank may agree either that the project comply with stricter emission requirements or that alternative measures should be implemented to reduce emissions from other sources to mitigate exposure and risk to the health of those within the airshed.

The *environmental assessment* should also address additional project-specific environmental concerns, such as emissions of cadmium, mercury and other heavy metals resulting from burning certain types of coal or heavy fuel oil. In such cases, the government and the World Bank will agree on specific measures to mitigate the impact of such emissions and on the associated emission requirements.

The following World Bank guidelines apply to new fossil-fueled thermal power plants or units of 50 megawatts or larger and have

been set at levels that can be achieved by adopting a variety of low cost options or technologies, including the use of clean fuels. The following are World Bank *recommendations:*

**Particulates:** For a coal-fired plant or unit, the recommended removal efficiencies from exhaust gases are 99 percent for all particulates (PM) and 98 percent for $PM_{10}$. These removal efficiencies are to be achieved at least 95 percent of the time that the facility is operating. For all facilities, emissions should not exceed 50 mg/$Nm^3$ for particulates under full load conditions (24).

**Nitrogen oxides:** For a coal-fired plant or unit a reduction in $NO_x$ emissions of 40 percent (relative to the case in which no $NO_x$ controls are installed) is recommended, to be achieved for 95 percent of the time that the plant or unit is operating. This should correspond to an emissions level of 650 mg/$Nm^3$ (230 ng/J). For an oil- and gas-fired plant or unit, the recommended reduction rates are 25 percent and 5 percent respectively, corresponding to emissions levels of 360 (100 ng/J) and 240 mg/$Nm^3$ (65 ng/J) (24).

**Sulfur dioxide:** It is recommended that total $SO_x$ emissions from the power plant or unit should be less than 0.20 tons per day per megawatts of capacity for the first 1000 megawatts plus 0.10 tons per day for the incremental over 1000 megawatts. The concentration of $SO_x$ in the flue gases should not exceed 2000 mg/$Nm^3$ (24).

## WATER STANDARDS

### Water Quality

Water quality *standards* do not differ to any significant extent throughout the world. USEPA standards and World Bank recommendations are presented in references 16 and 24, respectively. The reality is, unfortunately, that standards are ignored by local facilities in many parts of the world. It can not, however, be assumed that those developing new projects will be allowed much latitude in meeting water standards.

**Thermal Plumes**

Controlling the discharge temperatures and thermal plumes may be necessary in order to protect the aquatic environment from the effects of thermal pollution. The World Bank has set a limit (24) to the size of the thermal plume. The requirement states:

> *"The effluent should result in a temperature increase of no more than 3 degrees Celsius at the edge of the zone where initial mixing and dilution takes place. Where the zone is not defined, use 100 meters from the point of discharge."*

**Water Monitoring**

Requirements will be site-specific. The World Bank requires that:

> *"The pH and temperature of the wastewater discharges should be monitored on a continuous basis. Levels of suspended solids, residual chlorine, heavy metals, and other pollutants in wastewater discharges should be measured monthly if treatment is provided."* (24).

## SOLIDS STANDARDS

The World Bank has not published quantitative criteria for disposal of solids. Potential dangers are associated with dust and liquid runoff, rather than the mere existence of solids. Criteria for these are well established.

## EVOLVING VIEWPOINT

The World Bank is moving to an approach that focuses more strongly on operational monitoring and pollution prevention. Thus, future standards will be related to emissions per unit of production (e.g., grams per kilowatt-hour) and concentrations in streams that can be monitored.

Additionally, a larger viewpoint of a project will be adopted. An "offset" approach will be encouraged whereby reductions from other facilities will be encouraged where appropriate.

## PROBLEMS WITH STANDARDS

Several troublesome issues arise with surprising frequency in international projects.

+ Numerical values may be presented with no indication of what the units are (i.e., volumetric concentration, mass concentration, mass per unit of energy input, etc.)

+ Laboratory methods are not presented or referenced. The technical requirements are occasionally lower than can be practically measured.

+ Confusion often results from the use of different revisions of guidelines and standards.

## OTHER MULTILATERAL LENDING INSTITUTIONS

Project sponsors may become involved with any of several regional multilateral lending agencies. These include:

- **Asian Development Bank (ADB)**
- **European Bank for Reconstruction and Development (EBRD)**
- **InterAmerican Development Bank (IADB)**
- **African Development Bank (AfDB)**

All of these have a mission to improve the quality of life of the population of their region, and have a focus on sustainable development. They each have an Environmental Division that has issued environmental guidelines for selected industrial development projects, which include thermal power projects and power transmission lines, and have adopted systematic environmental procedures to review projects. They, moreover, assist their member countries to formulate and implement environmental policies, and play an active role in developing regional programs for transnational and cross-media environmental issues.

The environmental guidelines each has adopted are very similar to those of The World Bank. See, for example, references 1, 2, 3, 4, 5, 9, 10.

## MEETING ENVIRONMENTAL REQUIREMENTS

### Air Issues

Although the creation and emission of air pollutants is unavoidable when electric power is generated from combustion of fuels, their total mass emitted and the resulting ambient ground-level concentrations in the air we breathe are controllable. If the air quality standards will be violated from an uncontrolled facility, pollution control devices or processes must be used. The costs involved to meet the standards must, of course, be borne by the project.

The height of the discharge stack affects the ground level concentrations of pollutants; a taller stack reduces ground-level concentrations. Stack height, however, has no effect on the total mass of pollutants emitted. Using tall stacks occasionally, and correctly, leads to charges that pollution is merely being shifted from one location to another. Stack height can also be both an aesthetic consideration or safety issue if the plant is located near an airport or in flight paths. Zoning regulations frequently regulate the maximum height of a "structure," and must be carefully considered.

#### *Air Pollution Prevention and Control*

The simplest and, in many cases, the most cost-effective form of pollution control is to use cleaner fuels. Combined cycle plants burning natural gas have high thermal efficiencies, good environmental performance and low capital costs. If availability and price of natural gas eliminate this option, then the use of low sulfur fuel oil or low sulfur/low ash coal should be considered. Although cleaner fuels are more expensive, reductions in operating or environmental costs may make them more cost-effective. Other technologies include the following.

#### *$PM_{10}$*

Controls capable of 98-99 percent removal efficiency should always be installed. The options for removing particulates from exhaust

gases include use of settling chambers, cyclones, jet scrubbers, spray towers, electrostatic precipitators (ESPs), baghouses (fabric filters), and venturi scrubbers. Cyclones may be adequate for small boilers, but their overall removal efficiency is less than 90 percent for total suspended particulate matter and considerably lower for $PM_{10}$. Baghouses can have removal efficiencies of 99.8 percent or better and have the potential to enhance the removal of $SO_x$ when sorbent injection or dry scrubbing systems are used. ESPs are available in a broad range of sizes for power plants and can have removal efficiencies of 99.8 percent or better.

Choosing between a baghouse or an ESP depends on fuel and ash characteristics as well as operating and environmental factors. ESPs can be less sensitive to plant interruptions than fabric filters, because their operating effectiveness is not as sensitive to maximum temperatures and they have a low pressure drop. On the other hand, ESP performance can be adversely affected by fuel and boiler characteristics as well as by poor operating or maintenance procedures, so that actual removal efficiency falls below its design specification. Modern baghouses can also be designed to achieve very high removal efficiencies of $PM_{10}$ at capital costs comparable to those for ESPs when low sulfur fuels are used. It is necessary to ensure the availability of filters and provide appropriate training of operations and maintenance staff; factors that should be included in cost comparisons.

*$SO_x$*

These emissions can be decreased both for combustion turbines and internal combustion engines by limiting the sulfur content of their liquid fuel.

Other options and removal efficiencies include boiler sorbent injection which can remove 30-60 percent and flue gas desulfurization units which remove 70-90 percent.

The range of options for the control of $SO_x$ from boilers is greater because of large differences in the sulfur content of different fuels and in control costs. In general for low sulfur, high calorific fuels (<1 percent sulfur), specific controls may not be required. Coal cleaning (when applicable) and sorbent injection into ducts (leading to a 30 to 60 percent reduction) or into fluidized bed combustors (leading to a 95 percent reduction) may be adequate for medium sulfur fuels (1 to 3 percent sulfur). For high sulfur fuels (>3 percent sulfur), wet flue

gas desulfurization (scrubbers) which can achieve a 95 percent reduction should be considered. Flue gas desulfurization costs are substantial, however, due to high capital costs, high energy usage, use of chemicals, and disposal of residues. Integrated Coal Gasification—Gas Turbine plants may be economical in specific circumstances (13).

*$NO_x$*

These emissions can be decreased for combustion turbines by using low-$NO_x$ combustors, and further by chemical reduction with ammonia in a Selective Catalytic Reduction (SCR) system. SCR may also be applied to internal combustion engines, oil and gas-fired boilers. Reduction of 80 to 90 percent of the initial $NO_x$ is technically and economically practical. Boilers should employ low-$NO_x$ burners, reducing $NO_x$ emissions by 40 percent. There is increasing experience with SCR systems for coal-fired boilers.

*Provision for Future Needs*

The possibility that there may be changes in fuel composition and/or regulations will always exist. It may be economically prudent to provide space for future pollution control systems such as wet flue gas desulfurization, baghouses and SCR.

*Air Monitoring and Reporting*

Systems for continuous emissions monitoring (CEM) of particulates, $SO_x$, $NO_x$ and other pollutants including heavy metals in the stack exhaust can be installed at reasonable costs for coal and oil-fired power facilities. Direct measurement of $PM_{10}$, $NO_x$ and $SO_x$ in flue gas samples should be performed every 12 months along with the calibration of the CEM. Ash and sulfur content of the fuel should also be monitored (24).

Air quality monitoring systems may also be required to measure ambient levels of $PM_{10}$, $NO_x$ and $SO_x$ outside the plant boundary in several locations including:

- where there is the least influence of the power plant (the background)

- where the maximum pollution concentration is expected

- where there are sensitive receptors such as protected areas and population centers. The number of air quality monitors should be greater if the facility is located in areas prone to temperature inversions or other meteorological conditions which lead to high levels of air pollution affecting nearby populations or sensitive ecosystems.

## Water Issues

*Chemistry*

Chemical treatment technologies to maintain acceptable limits of wastewater composition are well known, and present no unusual problems. In extremely sensitive situations, it is possible, though very costly, to use "zero liquid discharge" systems. These are essentially complex evaporator systems requiring much chemical control and sophisticated plant operators.

*Thermal Plumes*

Designers may predict the thermal plume dimensions and temperature contours by using mathematical models that consider the discharge characteristics (flowrate, temperature, discharge geometry) along with the ambient receiving body conditions (depth, water current direction and speed, topography, temperature, etc.). Proper selection of various outfall dimensions and discharge location can normally lead to an acceptable situation.

*Water Monitoring*

It is neither difficult nor expensive to meet monitoring requirements for pH, temperature and composition of wastewater discharges. Although monitoring may be required for environmental protection, it is also justifiable as a way to detect changes in plant operation and ensuring that the facility is being properly maintained.

## Solids Issues

Dewatered ash and chemically stabilized sludges can be disposed of in landfills that have low permeability and/or are lined. Where there are heavy metals present in ash residues and flue gas desulfurization sludges, leachates and overflows from settling ponds

must be monitored and treated. The composition of the waste, together with local conditions and regulations, will dictate proper disposal methods.

## OBTAINING ENVIRONMENTAL PERMITS

The number of countries that have simple or nonexistent environmental regulations is dwindling. Environmental permits, that demonstrate that the extent and impacts of pollution have been properly considered, are now required for virtually any meaningful project in almost every country.

The definition of a "meaningful project" is somewhat subjective. The United States Environmental Protection Agency considers a project to be worthy of detailed analysis if its air pollutant discharge rates exceed tabulated "Significant Emission Rates" (15), or if the increase in ground-level concentrations exceeds tabulated "Significant Air Quality Impacts." (14). Naturally, many other factors may lead to a requirement for an intensive environmental review. Generally, projects between 20 and 50 megawatts may be environmentally meaningful, and projects above 50 megawatts are almost always subject to careful scrutiny.

The approval process for constructing and operating electric generation plants in many countries is long and complicated. Over the last several years most countries have developed some type of environmental government agency, but the power and effectiveness of these agencies varies widely. In countries with strict regulations a surprisingly large number of ministries, in addition to the primary one, have a strong interest in power projects. Each has its own layer of bureaucracy which must be satisfied before any binding resolutions can be reached.

Generally speaking, the types of permits necessary to construct and operate thermal power projects involve air, water, solid waste disposal, fuel storage and land use issues. These may be issued by national, state or provincial and local municipalities or agencies. Air emissions permits are usually handled on a national or provincial level. Some countries have their own environmental standards; others use international standards. In rare cases where a country itself has not adopted standards, World Bank, USEPA or other lending

institution standards may be proposed by the developer.

Water acquisition or discharge permits can be national, provincial or local. These depend on the location and amount of water necessary to run the plant and its source. Discharge permits depend on the destination of the discharge. For instance discharge to the ocean or a large lake would be a national concern, while discharge to a sanitary sewer system would be a local concern.

Solid waste disposal could also be a national or local issue depending on the size of the country. Fuel storage is probably local since any emergency will affect only the immediate area (except for nuclear disasters). Land use is also defined locally, except for large hydroelectric projects.

Although noise standards may be national, they are usually administered locally. While noise is not usually an "emission" that needs a specific permit, it is important to consider its magnitude since it is one of the most frequent causes of complaints, and can be readily abated during the project design phase.

## Basic Requirements for Obtaining Permits

Before environmental issues can be tackled the most basic requirement is obtaining clear answers to three simple questions:

*"What do you want to build?"*
*"Where do you want to build it?"*
*"How do you want to operate it?"*

Changes in any of these can not only affect the types of permits required, but also make an impossible project possible or vice versa. Lack of a clear basis for operating scenarios, plant engineering and equipment selection add to the cost and timetable of the environmental analysis of the project. Each time major components change so do calculations and evaluations. Once the project is defined a list of the agencies that will be involved with the permitting and licensing of the project, and all applicable regulations, can be prepared.

## Pre-Application Activities

Initial informal contacts can be made with appropriate agencies, and the proposed project described to officials and their staffs. They will normally voice their concerns, allowing project sponsors to assess

the likelihood of success and a realistic timetable for securing permits. Very often, they will express strong enthusiastic support for the project; occasionally it is real.

A more formal scoping meeting will help identify obstacles which must be overcome such as uncertain operating scenarios, lack of site-specific data, lack of standardized analytical methodologies, and lack of trained technical staff. Effects on the local and regional infrastructure, must be assessed and the public must be allowed to comment. Alternatives or mitigation measures should be discussed if appropriate. Local concerns should be identified as early as possible in the project development.

Summarize the meeting results in an internal memo with your understanding of the local position and concerns. Send a copy of the memo to the agencies it applies to for their informal review and comment. This will avoid any misunderstandings or misinterpretations.

After receiving an informal response, prepare and send each involved agency a formal summary of points agreed upon asking for written confirmation of its points. Carefully prepare all applications, discussing your approach and assumptions with each concerned agency as you work. Once you submit the applications follow their progress with telephone calls or visits. Respond to comments in a timely, candid and professional manner.

**Permit Reconnaissance**

Since permits and approvals and licenses are on the critical path for project development, it is extremely prudent to complete a "Permit Reconnaissance" as early as possible. Properly done by those with broad and current experience, it will identify appropriate government agencies, areas of particular concern, the most time consuming activities, public notification requirements and potentially fatal flaws. Upon completion, a permitting timetable can be developed showing the sequence of approvals.

As noted previously:

*Often, the nation in which the facility is to be located is not the entity that sets the most stringent criteria to which a project must conform.*

Extensive research and care must be taken to identify qualifying

standards, permitting procedures, appropriate governmental and financial agencies that will be involved, documentation requirements and other site-specific issues.

Dynalytics typically prepares a project-specific report that indicates the situation with respect to obtaining licenses, permits and approvals to construct and operate an independent power plant in any location throughout the world. All major licenses, permits and approvals will be addressed, including requirements of environmental, zoning and land use regulations. Depending on the developer's needs, Dynalytics typically addresses the following:

- Regulatory basis for requirement (legal citation)
- Office that issues permit, with Contact Person's name, title, address, telephone number and FAX number
- Method of application (application form, letter, etc.)
- Significant Issues
- Approval process—Internal ("one-stop," multi-agency reviews, etc.)
- Approval process—External (advertisements, public hearings, etc.)
- Anticipated Approval Time
- Fees
- Likelihood of obtaining permit in an acceptable time period
- Other issues as appropriate for a specific project and location

It is important that this Permit Reconnaissance be based on information obtained from competent, responsible and experienced parties. Sources of information include knowledgeable consulting firms, local and United States government staff, information brokers and others with formal training as information professionals. Techni-

cal and procedural information is becoming increasingly available electronically through the Internet.

It is exceedingly important to insure that all permit requirements and their significance are clearly understood. An overall licensing, permitting and approvals schedule can then be developed showing the inter-relationship between each permit and the various procedural and engineering tasks involved to gain approval.

**Define Environmental Design Basis**

It is critical to establish emission and discharge limits that are simultaneously technically and economically attainable, can be adhered to by plant operating personnel with reasonable training and efforts, and that are acceptable to the regulatory community. Unless all three conditions are met the project is unlikely to succeed.

**Documentation, Applications, and The Environmental Review Process**

This article is focused on environmental issues which must be addressed in order to obtain the approvals and licenses necessary for realizing electric sector projects. Certain documents will be necessary for government regulatory agencies and the same or additional documents will be required by the financial institutions. A list of documents needed for financial closing will include the power purchase agreement, fuel supply and transportation agreements, the engineering-procurement-construction contract and the operating and maintenance agreement. Other necessary documents include engineers reports and various approvals and licenses as well as any environmental land use approvals or licenses or environmental reports.

**Obstacles to Obtaining Environmental Permits**

Environmental permits may be difficult to secure for a variety of reasons. Dynalytics places the difficulties in four categories: serious environmental problems exist; there is local or governmental opposition; applications have not been carefully prepared; the Regulatory Staff is insecure. These will be discussed in turn.

*Serious Environmental Problems Exist*

Dynalytics' direct experience with many regulatory agencies and many Western companies indicates that virtually all Western de-

velopers accept their responsibility to protect the environment and, when presented with a situation that is objectively untenable, will modify the proposed plant design, operation or location. In addition to the philosophic and moral issues, the Project Development process is simply too lengthy and expensive for problematic projects. These will be dropped and another selected from the many more attractive opportunities existing throughout the world.

*Local or Governmental Opposition*

Local or governmental opposition presents the developer with an extremely difficult dilemma since objections are often couched in environmental terms. The nature of the objections must be analyzed and a decision made as to whether or not they might be overcome in a reasonable time. Objections are usually site-specific, including perceived damage to the environment, aesthetics or existing business interests. A sophisticated Public Relations company can assist with gathering and interpreting public opinion data, and establishing a sensible course of action. Applications will, as a practical matter, not be submitted for truly objectionable projects.

*Incompleteness*

Most reviewing agencies have experienced competent staff. They, moreover, are willing to commission independent experts to assess controversial situations, or to provide specialized expertise. Environmental documents will *always* be reviewed with respect to the following.

> *PROJECT DESCRIPTION:* Major equipment selected and operating scenarios, such as part-load profiles, plans for handling gas curtailments, types and compositions of fuels, delivery methods and storage scenario with amounts of fuels to be stored and emergency precautions related to containment and treatment of oil spills, method of cooling/condensing and noise mitigation measures
>
> *SITE:* Description of the site including its location, proximity to wetlands/forest or other conservation areas and flood-plains (if appropriate), land use/zoning requirements, base-line air pollutant and noise data

*AIR:* Quantities and emission rates for air pollutants for various realistic operating scenarios, types of control equipment, guaranteed emission rates, predicted ground-level concentrations and comparisons with established criteria

*WATER:* Quantity and source of water, method of treatment, waste-water discharge quantities, compositions, temperatures and disposal methods, and effects on the environment

*SOLID WASTE:* Characterization of solid and hazardous wastes, disposal methods, and effects on the environment.

*NOISE:* Ambient noise levels resulting from operation, during daytime/nighttime hours at the site boundary and at any sensitive receptors

*POSSIBLE ALTERNATIVES:* A brief discussion of alternative fuels, sites and technologies to establish the reason for the proposed selection

*COST/BENEFIT ANALYSIS:* A brief discussion of alternate pollution control technologies, with reasons presented for the options being proposed.

*Inconsistencies in Environmental Analysis*

Many documents are required in the development of a project including environmental permits, fuel supply/transportation agreements, power purchase agreements and the Engineering-Procurement-Construction (EPC) contract (6). It is important that the project descriptions and quantitative information presented be consistent. This is a difficult feat as each document may be executed during a different phase and the operating scenarios or equipment, selection and size may change from one time period to another. Following are some specific examples of items which need attention to consistency.

**a. Between the Power Purchase Agreement, the Fuel Supply/Transportation Agreement and the EPC Contract**

- Fuel analysis
- Handling of gas curtailments
- Consistency with design capacity and load factors

**b. Between the Power Purchase Agreement and the Thermal Sales Agreement**

- Consistency of fuel usage with design capacity/load factor
- Consistency of water usage, discharge rates and characterization with design capacity and load factor

**c. Within the EPC Contract**

- Stack height & diameter, building dimensions
- Emission levels and equipment specifications
- Water usage and discharge details
- Noise levels

*Insecure Regulatory Staff*

The Regulatory Staff, in many countries, has an excellent technical education and often been exposed to a wide variety of operating plants. They, however, very often see no advantage to recommending acceptance of a developer's position and approving an application for a permit. They, in fact, worry about being associated with any controversy that may arise, particularly with high-profile projects. Any positive decision is viewed as a severely career-threatening step.

An insecure staff member takes two defensive positions.

- **Makes unending requests** "We need additional information; We need additional information; We need additional information; We need additional information..."

- **Focuses on procedural matters** "We have a new form; The form was not filled out properly; The form was not filled out completely; The form was not properly certified; The form was not properly delivered; The form does not have all the required attachments; The form..."

**Dynalytics' experience throughout the world indicates that staff insecurity is the most common problem, and by far the largest cause of delays in securing permits.** It may be alleviated by devoting a great deal of time to educating regulatory staff, and being careful to include senior-level agency members in the process.

**Project Modifications**

An experienced environmental consulting firm should be involved early in the siting and design process to maximize the chance of successfully receiving all required permits, licenses and approvals. Viewpoints can be offered concerning the choice of locations which would pose the least environmental impact, pollution limits that will be acceptable, and many intangible and subjective factors that affect project viability. If severely negative impacts can be avoided in the planning stage, they will avoid costly changes or future community opposition.

A major issue which leads to delays and drives up the environmental costs of the project are the number of changes in operating or siting scenarios that must be evaluated. Early inclusion of environmental permitting experts can help avoid repeated modeling scenarios and report rewrites.

**Post-Construction Requirements**

The host country may or may not have follow-up requirements to keep facilities in compliance with the requirements of their permits. These would include:

*Permit Restrictions*

Permits may be issued with conditions such as restrictions on the number of hours a plant may operate using a certain type of fuel, or the quantity of a particular fuel used per year, or times when truck deliveries are not allowed.

*Monitoring and Record-keeping*

Monitoring requirements for air and water vary widely from country to country. Record-keeping and proper operations of equipment may be a problem if local personnel operate the plant without proper training or experience.

*Enforcement*

Unfortunately, even if countries have established standards, appropriate environmental regulations are often not in place. Enforcement is generally weak and poorly funded. Existing facilities, particularly if government-owned, are very often not held to strict criteria

that appear in written regulations. In many countries there are no mechanisms, monetary resources, technical skills or political willpower to enforce regulations, eliminate duplication of responsibility, and establish clear lines of authority. Environmental protection is often a low priority factor, as concern is concentrated on more immediately pressing social problems. **Those developing new projects must not, however, assume they will be treated in the same lax manner.**

## TRENDS

### Governmental

Governments are increasingly having to respond to concerns about the environmental consequences of existing energy development strategies. As nations see the negative effects of unregulated pollution on their populations and their resources, they are beginning to adopt strict regulations to abate pollution. The problem is often not the fact that regulations are not in place, but that enforcement is not practiced because of manpower and economic constraints. In areas where local governments have not taken the initiative to create regulations other entities such as multilateral lending institutions, impose their standards. It is, moreover, not unusual for a country's energy officials to act autonomously, even within the energy sector. Structural reforms have been brought about in many countries by deregulation, financing needs and consumer pressure. There is also a sharp increase in global and transnational agreements to decrease the dangers associated with the greenhouse effect and acid rain, issues which go beyond the jurisdiction of a single country.

*Overseas Private Investment Corporation (OPIC) is* now claiming that the Foreign Assistance Act of 1991 imposes a duty to see that projects it insures do not "pose unreasonable or major environmental hazards to, or cause degradation of the tropical forests." They are now insisting on broad environmental covenants, including that project activities will comply in all material aspects with World Bank thermal power plant guidelines. This will be difficult to interpret since the guidelines are, inevitably, not absolutely specific in all details.

## Financial Community

Banks have progressed from the reactive approach of solving environmental problems as they arose to a proactive approach. The latter identifies and even anticipates problems by examining proposed projects from both economic and social points of view, and are evaluating plans in an ever increasingly comprehensive manner. They are focusing on economic and environmental sustainability and citizen input. Orientation has shifted toward stronger policies and sharper focus on project quality. Also the impacts far beyond the immediate project site are considered. No longer are just local impacts assessed, but global issues such as global warming and greenhouse effects are also included.

In practice, consumers, utilities and public interest groups and governments participate to greater or lesser extent in the process of making decisions about the acceptability of new energy projects. Each group frequently has its own technical and legal experts to deal with multiple criteria involving economic efficiency and social issues, including environmental concerns. This leads to a variety of environmental targets, data formats, application and review procedures for each project depending on the country, the regional location and the financial institutions that are involved.

## Litigation

Extensive and intensive litigation of almost any issue had been a practice unique to the United States. Importantly, the World Bank now has instituted an appeals process by which interveners can "litigate" projects on environmental grounds thus delaying or even stopping them. An independent Inspection Panel has been established that will review controversial issues and make recommendations. Dynalytics expects all other multilateral lenders to follow suit.

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Dr. Cooper has also guided Dynalytics' successful efforts to establish several international joint ventures, participating in them as an equity owner and as managing partner. The experiences of negotiating with senior staff of major trans-national companies and high-level government officials of foreign countries have provided him with keen insight into recognizing opportunities and overcoming challenges in the multi-cultural global arena.