Environmental management of industrial parks: case study of Pequiven’s Jose Complex

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Abstract
Pequiven, a subsidiary of Petróleos de Venezuela, manufactures petrochemical products and sells them in domestic and international markets. It gives full support to enforcing worker safety and environmentally sound operating procedures that reduce risks to the environment and communities while complying with international and local legislation. This article presents the general programmes Pequiven has established for day-to-day safety and environmental management and recent experience with the environmental management of industrial parks.

Résumé
Pequiven, filiale de Petróleos de Venezuela, fabrique des produits pétrochimiques qu’elle vend sur les marchés nationaux et internationaux. Elle cautionne sans réserve l’adoption de mesures pour la sécurité des ouvriers et de procédures d’exploitation qui réduisent les risques posés à l’environnement et aux communautés tout en respectant la législation locale et internationale en vigueur. Cet article présente les programmes généraux que Pequiven a élaboré pour assurer la sécurité quotidienne de ses employés et la bonne gestion de l’environnement. En outre, il relate des expériences récentes en matière de gestion écologique des parcs industriels.

Resumen
Pequiven, una subsidiaria de Petróleos de Venezuela, fabrica productos petroquímicos y los vende en el mercado interno e internacional. Brinda un apoyo completo al refuerzo de la seguridad del trabajador y a procedimientos de funcionamiento que acústicamente respeten el medioambiente, que reduzcan los riesgos para el medio ambiente y a las comunidades, al mismo tiempo que cumplan con la legislación internacional y local. Este artículo presenta los programas generales que Pequiven ha adoptado para la seguridad cotidiana y la gestión medioambiental y la experiencia reciente con la gestión medioambiental de parques industriales.

Introduction
Pequiven, a subsidiary of Petróleos de Venezuela, is a company that manufactures petrochemical products and sells them in both domestic and international markets. Its aim is to develop the Venezuelan petrochemical industry into a regional leader, based on the comparative advantages that the country enjoys, while fulfilling the needs of its customers and achieving the highest possible yield for the shareholder.

Pequiven directly employs 4200 workers. It operates three petrochemical complexes located at El Tablazo in the west of the country, Morón in the centre, and Jose in eastern Venezuela. The company also owns a BTX plant at the El Palito refinery and the Borburuta Marine Terminal, both located close to Morón. It has two wholly owned subsidiaries, as well as direct interests in 17 joint ventures with both local and foreign partners.

Pequiven is organized in three business units which are responsible for the development of a wide range of over 40 products: olefins and plastics, fertilizers, and industrial products (aromatics and oxygenates).

For the near future, Pequiven is examining with prospective partners the feasibility of carrying out major new projects around the Anzoategui Petrochemical Complex at Jose. Eastern Venezuela is a region with considerable natural gas reserves. These projects envisage the construction of world-scale plants for the manufacture of olefins and fertilizers. They provide the launching base that will take Pequiven production from the current 7 million to 15 million metric tonnes per year by 2005, enabling it to consolidate its presence in international markets.

Pequiven is fully conscious that the achievement of its goals will depend on project execution being carried out in harmony with the environment and with the communities where it operates. It is therefore giving its full support to the implementation of this policy, enforcing worker safety and environmentally sound operational procedures that reduce risks to the environment and communities while complying with international and local legislation. The recognition that a growing awareness of the need for resource conservation among scientific, political and community sectors is placing new demands on the industry amply validates the need to set new trends in the environmental and safety management of our business.

Environmental and safety programmes at Pequiven
As we said before, Pequiven is fully committed to a long standing safety and environmental policy. Known internally as the Corporate Integral Protection Policy, it addresses itself to the responsibility inherent in each worker to perform his job giving all his support to the accomplishment of the Safety and Environment Policy in a safe and environmentally sound manner, in order not only to protect his health and physical integrity but also to reduce risks to the environment and the community. The Policy also requires strict adherence to laws, regulations and standards, as set forth by the government or by the company.

Over the years, the Policy has been the object of a continuous improvement process. In the company’s early stages, from 1954 to 1975, it ran Safety and Industrial Hygiene Programmes reporting to the Human Resources Department. Later, in 1976, it also developed the Environmental Protection Programmes under the Technical Department. Finally, in 1984, Pequiven brought both activities under one roof by setting up the Corporate Integral Protection Department. We have, since then, been climbing the learning curve, updating our technical knowledge, of all these issues and learning from our own experience. Since October 1992, we have also taken over the Venezuelan Responsible Care programme, sponsored by the Chemical and Petrochemical Industrial Association (ASOQUIIM).

We will now focus on the general programme: we have established for day-to-day safety and environmental management:

Management: Safety and environmental aspects are integral parts of business activities. Therefore, adequate resources are provided. Every worker is responsible for good performance in Integral Protection activities.

Training and education: It is a priority to ensure that all workers are working on the Pequiven installation. including temporary employees and contractors. They receive appropriate education and training on hazard identification and correct handling of tools and materials, together with emergency and job
related procedures. This is made mandatory by law, with the employer held responsible for training and information on hazards.

Operating procedures: Written operating procedures and instructions are made available in order to satisfy the design intent of the installation and maintain its integrity. These procedures include instructions for handling abnormal conditions, emergency shutdown procedures, startup procedures, etc.

Hazard identification and quantification of risk: Critical examination techniques, such as hazard analysis, hazard and operability studies (HAZOP), and fault tree and event tree analysis, are applied in order to identify and rank critical hazards. These studies also make it possible to eliminate or reduce risks, providing guidance for decision making on preventive measures.

Maintenance programmes: Maintenance, inspection and testing of equipment are conducted on a regular basis to ensure that they continue to be appropriate in relation to safety and environmental requirements. The programme also includes record keeping on safe maintenance procedures and equipment reviews and reliability assurance procedures.

Management of change: Neither repair work nor modifications to plant equipment, processes, facilities or procedures can be done without a registered and assessed analysis, so that the necessary hazard studies are carried out, the appropriate design considerations are made, and the changes proposed are engineered and recorded.

Industrial hygiene and medical surveillance: This programme focuses on the evaluation and control of physical, chemical, ergonomic and biological factors in the workplace. It also includes all medical examinations that contribute to worker health evaluation.

Safety, health and environmental procedures: This programme includes all standards, such as work permit procedure, confined space permit procedure, accident investigation and record keeping, personal protective equipment procedures, air emissions standards, etc.

Emergency planning: On-site and off-site emergency plans are being reviewed regularly. All personnel involved in emergency response are being trained to assure their capability.

Auditing: Pequiven has recently developed a self-auditing procedure to evaluate the effectiveness of its programmes, compliance with the law, and the whole organization's performance in relation to the Integral Protection Policy. These audits not only enforce programme compliance, but also help identify needs for additional resources or further administrative measures. Figure 1 shows some of the aspects to be checked.

Pequiven's Jose Complex: case study
Pequiven's Jose Complex is officially named "Complejo Petroquímico José Antonio Anzoátegui". Located at Jose, in the State of Anzoátegui on the eastern
Venezuelan coast, it covers 2177 hectares, of which Pequiven has so far developed only about 12 per cent.

The complex is designed to provide services and infrastructure facilities to prospective joint venture partners. It provides:
- fresh water, supplied from the Neversi river to the site via a 30-inch pipeline, with 600 litres per second pumping capacity;
- electricity, up to 120 MW, provided from the Raul Leoni hydroelectric dam;
- fuel gas and natural gas, supplied by Pequiven on behalf of Corpoven, a Petroleos de Venezuela subsidiary;
- leases for administration offices;
- firefighting services;
- medical services;
- overall security and maintenance of perimeter roads.

At the moment, Pequiven's Jose Complex has one MTBE plant that came on stream in 1991 and two methanol plants that started up in 1994.

For the near future, Pequiven is examining the feasibility of new developments in the areas of fertilizers and olefins.

Without entering into in-depth analysis of the petrochemical processes at Jose, either present or future, it should be recognized that some raw materials and products may represent potential risks to health, environment and property. Consequently, we have adopted the use of hazard analysis and risk management methodologies.

As a first step, Pequiven conducted its first Environmental Impact Assessment (EIA) at Jose from July 1987 to August 1988, when neither national laws nor local regulations required it. This permitted the evaluation of potential impacts on the future industrial park and its surroundings. Original park design initially contemplated the construction of infrastructure and the MTBE plant. Despite original misgivings concerning some of the EIA findings, the technical team soon gave them unstinted support when it was seen that the new courses of action recommended actually produced net savings in construction costs. Since then, EIA is widely accepted as a valuable tool for new project development.

Some examples of the adverse impacts identified by EIA in the construction and operation phases are shown in Figures 2a-3a. The related mitigation measures recommended in order to minimize these impacts are shown in Figures 2b-3b.

The final EIA report established 29 recommendations to minimize adverse impacts and improve human environmental quality. Following provides a general recommendation summary:
- prevention and control of industrial pollutants through the design of a general plan for the environment; this is continuously updated in accordance with technical and regulatory changes;
- provision of further risk evaluation and quantification studies to identify zones of impact on communities at risk, as soon as those studies were concluded, a safe zone around the complex was defined, thereby establishing restrictions on the encroachment of neighboring housing;
- provision of clean drinking water and the establishment of a minimum level of sanitation;
- promotion of urban quality and the protection of historical and cultural sites.

EIA also provided the basis for drawing up guidelines for the safety and environmental management of the industrial park.
- The development of new projects – from the initial feasibility stage to actual physical construction – will require that Environment Impact Assessment (EIA) and other processes analyses (Preliminary Hazard Assessment – PHA; Hazard and Operability Studies – HAZOP) are conducted in order to identify potential risks at early stages.
- The use of Clean Technologies in all industries processes to be installed at the park is given a highly desirable; however, in those cases where the use of even the most advanced technologies may still produce waste streams, joint ventures will have to be set up for the purpose of building and operating treatment units that satisfy environmental regulations.
- The operators of each plant to be installed are responsible for their own performance in safety, health and environmental aspects. At present, all ventures currently in operation have developed programmes on waste minimization, air emissions control, safety processes, industrial hygiene, etc.
- Pequiven is to act as the principal coordinator of all activities within the complex in its role as the industrial services provider, as already mentioned. It will also, through our function, promote, coordinate and audit compliance with environmental, safety, and health regulations.
- When additional general studies on safety at the environment touching on overall operation are required. Pequiven will act as project coordinator, sharing out study costs among the joint ventures. Examples of current studies are:

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**Figure 2a**
Pequiven Jose Complex environmental impact assessment
Some examples of impact characterization
Phase: construction

<table>
<thead>
<tr>
<th>Impact code</th>
<th>Impact description</th>
<th>Impact target</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF02</td>
<td>Dredging material from jetty construction activities</td>
<td>Marine ecosystems</td>
</tr>
<tr>
<td>CF03</td>
<td>Modification of the natural conditions as a consequence of construction activities</td>
<td>Drying channels, coastal vegetation</td>
</tr>
<tr>
<td>CF04</td>
<td>Soil pollution caused by improper waste disposal</td>
<td>Soil Underground waters</td>
</tr>
<tr>
<td>CF05</td>
<td>Water pollution caused by improper sewage waste disposal</td>
<td>Continental and marine waters</td>
</tr>
</tbody>
</table>

**Figure 2b**
Pequiven Jose Complex environmental impact assessment
Some examples of mitigation measures
Phase: construction

<table>
<thead>
<tr>
<th>Related impact code</th>
<th>Measure description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF02, CF05</td>
<td>Provision to develop further studies to evaluate the sensitivity of the coastal marine ecosystems in order to prevent stress on them.</td>
</tr>
<tr>
<td>CF03</td>
<td>To restore the natural conditions in the north area of the Complex to help natural species (flora, fauna) to return to their habitat. This also includes a general clean-up.</td>
</tr>
<tr>
<td>CF04</td>
<td>Collection, transport and final disposal of domestic wastes. This measure includes recommendations on collection, frequency, waste classification and its transport and final disposal at the local landfill.</td>
</tr>
<tr>
<td>CF05</td>
<td>Collection, treatment and final disposal of sewage waste during the construction of the Complex. It includes temporary controls (e.g. septic tanks) and recommends the early construction of the collection system and treatment plant.</td>
</tr>
</tbody>
</table>
Figure 3a
Pequiven Jose Complex Environmental Impact Assessment
Some examples of impact characterization
Phase: operation

<table>
<thead>
<tr>
<th>Impact code</th>
<th>Impact description</th>
<th>Impact target</th>
</tr>
</thead>
<tbody>
<tr>
<td>0F01</td>
<td>Fugitive air emissions affecting the surroundings</td>
<td>Air quality, vegetation</td>
</tr>
<tr>
<td>0S14</td>
<td>Potential risk of fire and explosions</td>
<td>Property loss Environmental impact</td>
</tr>
<tr>
<td>0F04, 0F05</td>
<td>Soil and water pollution caused by improper hazardous waste disposal</td>
<td>Marine coast, soil, underground waters</td>
</tr>
<tr>
<td>0S10</td>
<td>Noise generation</td>
<td>Workers' health Community comfort</td>
</tr>
</tbody>
</table>

As you can see, Pequiven is determined to carry out the development of its operations under sound environmental management and has empowered our function with enough authority to ensure that that policy is carried out. We are convinced that what we have learnt, and continue to learn, from our company’s expansion is of value to our country's industrial development. This had led us to work closely with national and local government, industry and communities, contributing our experience to the drawing up of laws and regulations in the belief that informed opinion provides a contribution to sustainable development, with better health and a safer environment for everyone, as well as promoting a common understanding of the need for industrial development and the importance of its contribution to society's welfare.

Figure 3b
Pequiven Jose Complex Environmental Impact Assessment
Some examples of mitigation measures
Phase: operation

<table>
<thead>
<tr>
<th>Related impact code</th>
<th>Measure description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0F01</td>
<td>Provision of process and operational controls to eliminate or reduce hydrocarbon emissions to the air.</td>
</tr>
<tr>
<td>0S14</td>
<td>Provision of safety process and operational controls to eliminate or reduce the risk of fires and explosions. The measure includes hazard and operability studies at early stages in a project or when a change takes place. Emergency planning is also required.</td>
</tr>
<tr>
<td>0F04, 0F05</td>
<td>Collection, treatment and final disposal of hazardous wastes.</td>
</tr>
<tr>
<td>0S10</td>
<td>Develop a noise control and hearing conservation programmes.</td>
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</tbody>
</table>