ENVIRONMENTAL AND REGULATORY ASPECT STUDY ON THE HARBOR EXTENSION DEVELOPMENT OF PETROLEUM AND PETROCHEMICAL INDUSTRIES

by
Desrina

I. INTRODUCTION

Petroleum and petrochemical industries are those industries involving huge amount of products that shall be transported across regional and even international boundaries. Accordingly, many of these industries have their own special harbor or port to accommodate ships that are in and out of the harbor for the purpose of transporting their products. Industries having their own harbor for example are, among others, Pupuk Kalimantan Timur (PKT) in East Kalimantan that produces Ammonia and Urea, and Pertamina Cilacap in Central Java that produces fuels.

As general harbor facilities that need maintenance, this special port has also to be maintained and sometimes extended due to the needs for accommodating bigger ships. Maintenance dredging is one of a harbor maintenance programs for keeping the berth that is always suitable for the ships. When the production of the industries has to be expanded for example due to demand for export purposes, the harbor that supports this activity has also to be extended. Some harbors even need a new area for developing harbor extension, because the old one is not sufficient for accommodating bigger ships.

The harbor extension development will involve several activities, namely (i) dredging of the coastal sediments, (ii) coastal reclamation with the use of some of the dredged materials, (iii) dumping of the dredged materials, and (iv) development of ship-waste reception facilities. Every phase in the harbor extension activity will undoubtedly impact in some extents to the environment surrounding the project. The potential impacts of the project to the environment will depend on the scale (area and volume) of each phase and the duration of the activities. The Ministerial Decree of Environment No. 17/2001[1] describes the scale limit of the project that has to be preceded by the environmental impact analysis (EIA), or AMDAL study in order to get governmental permit before the project can be implemented. This is certainly valid for a new project that its environmental area has not been studied yet.

Generally, many of the petroleum and petrochemical industries have been established long before the No.17/2001 decree being put into effect. The area of the port extension project in which this study was conducted is located in the area that has been studied through Environmental Evaluation Study, SEL (*Studi Evaluasi Lingkungan*)[2]. Basically, this environmental study covers all over the sphere that has been intended for the industrial activity. There are questions that may arise concerning with the extension project in this area. Should EIA/AMDAL study be conducted for this extension project? Is UKL/UPL (Environmental Management Effort/Environmental Monitoring Effort) study sufficient for this purpose? Regarding that the project scale may exceed the scale limit as described in the No. 17/2001 decree, shall RKL/RPL (*Rencana Pengelolaan Lingkungan/Rencana Pemantauan Lingkungan*) – Environmental Management Plan/Environmental Monitoring Plan – be revised?

For the purpose of harbor extension, beside the feasibility study which has been covered in the Master Plan Document, it is worthy to describe an environmental review and consideration regarding the activities that might result in an impact to the project surroundings. This environmental review that can be considered as an environmental rapid assessment is beneficial for the project management to have knowledge in making a decision concerning with the selection which the environmental studies (AMDAL, RKL/RPL, or UKL/UPL) that should be conducted prior the implementation of the project.

This paper describes a study that has been conducted concerning the port extension of the petrochemical industry in East Kalimantan, where the SEL for that area has been established. The study emphasizes on the discussions on the environmental and regulatory aspects, in order to have background knowledge leading to the detail environmental management and monitoring study that

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shall be conducted prior the implementation of the project. The review is divided into two basic issues, namely dredging activity and ship-waste reception facilities. Due to related issues in dredging activities, review concerning dredging, coastal reclamation and dredged material dumping are grouped into one paragraph, while those of ship-waste reception facilities in other paragraph.

II. ENVIRONMENTAL ASPECT CONSIDERATIONS

A. *Dredging*

The main objective of dredging in the harbor extension of the project of the studied area is the creation of deeper water in order to accommodate the access of bigger vessels (up to 60.000 DWT) to the newly constructed berth to a depth of -15 m LWS. The quantity to be dredged is estimated to be equal to 3,395,000 m3. Depending upon the dredged materials obtained, some of the dredged materials will be used as landfill at the studied area. However much of the dredged material shall be dumped at sea within a determined area. These activities will undoubtedly have environmental consequences which have to be assessed prior to executing the project.

1. Sediments and Dredging Operations

Deposits of sediments found within most port can be divided into two primary classes[3]:

1) Deep sediments, typically representing the major fraction forming the layers of the sediment column and known to have been in place for times that are long compared to the local history of industrialization,
2) Surficial sediments, the more mobile fraction, found at or near the surface of the sediment column and typically of incoming sediments.

The later group includes the materials of primary concern for most dredging project. The rate of deposition of surficial materials governs the extent and frequency of maintenance dredging. The frequently elevated levels of contaminants in these sediments (as indicated by concentration of **oil and grease**, **trace elements**, and **long-lived synthetic organic compounds**) lead to concerns about potential short- and long-term effects associated with mobilization, dispersal, and uptake of contaminants from re-suspension by dredging and from the disposal of dredged sediments.

In contrast, deeper sediments are frequently disturbed or displaced. They typically display a chemical composition that differs slightly from the earth's average crustal materials in the drainage basin, and exhibit little evidence of anthropogenic activities. These characteristics favor limited adverse effects following from the displacement of these materials.

Recent surficial sediments are composed of materials arriving from a number of sources by atmospheric and waterborne routes. From a mass-flux standpoint, waterborne inputs significantly exceed atmospheric contributions. The primary sources of waterborne materials include erosion of adjoining lands induced by rainfall and runoff, stream bank and channel way erosion, biological activity in the water column and at the sediment-water interface, and the landward transport of sediments suspended over the adjoining continental shelf or adjoining estuary. In addition to these natural sources, particulates are introduced to ports by a variety of anthropogenic activities, including the discharge of sewage effluent, industrial outfalls, direct dumping of debris, and discharges from street drainage and flood-control systems.

In general, concerns about dredging and disposal of dredged materials focus on elevated concentrations of selected trace elements, principally **cadmium**, **mercury**, and **lead**, and the synthetic organics, with recent emphasis on **polychlorinated biphenyls** (PCB) and **polynuclear aromatic hydrocarbons** (PAH). Other constituents of concern include the nutrients, phosphate, nitrate, and ammonia, oil and grease, and pathogenic organisms. Because of the relatively large volumes of surficial sediments being dredged, the presence of elevated levels of these constituents prompted more stringent controls on dredging and disposal. This can be performed by the initiation of variety of field and laboratory studies to assess the range of potential effects and to establish procedures to mitigate adverse effects.

Both mechanical and hydraulic dredging operations introduce significant quantities of sediment into the water column immediately adjacent to the operation dredging. For mechanical operations in areas of moderately fine-grained cohesive sediments, concentration of suspended materials adjacent to dredge have been observed to exceed background levels by more than two orders of magnitude.

The materials suspended by the operating dredge are distributed downstream by the local transport field, and show concentrations varying as a function of mass-settling properties, free-stream velocity, and associated

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turbulent diffusion characteristics. In addition to the solid particulate phase, the operating dredge also directly and indirectly alters the concentrations of dissolved nutrients and selected trace elements within the waters in the immediate vicinity of the dredge. Studies of these constituents indicated elevated concentrations above background within an area representing approximately 30 percent of the total suspended material plume. Over the remaining area of the plume, dilution and particle scavenging favor a return to background levels.

The limited spatial extent of the suspended material plume produced by the typical estuarine dredging operation effectively limits the associated effects to areas immediately adjacent to the operating dredge. Within this region, the elevated suspended material concentration serves to:

i Increase turbidity, which reduces the penetration of light and associated photosynthetic activity

ii Provide a continuing supply of sediment for deposition along and over adjoining benthic areas.

The potential effects associated with these material concentrations appear to be limited by combination of factors. Within the water column, the effects of particulates on the drifting biotic community, including zooplankton, are considered negligible because of the limited area affected and the characteristically short exposure time. For the more mobile, free-swimming organisms, potential effects are further reduced by their ability to avoid the re-suspension area. The benthic biological community not effected directly by dredging can be affected by the rain of re-suspended sediments. The rapid settling of these materials serves to confine the primary effects to the immediate vicinity of the operating dredge, resulting in zones of influence having characteristic spatial scales ranging from 100 to 1000 m^2.

The deposition of suspended sediments within this area affects particularly the filter-feeding organisms, including several species of commercial value such as oysters, scallops, and muscles. The extent and character of the effects varies as a function of the concentration levels of suspended sediments, sedimentation rate, and exposed species. Persistent concentrations in excess of 2 gram/liter, or deposition sufficient to produce deep burial (> 20 cm), or both, can prove lethal to a majority of benthic organisms.

2. Upland Disposal

Upland sites and sites fringing the shoreline have been primary receiving areas for dredged materials. Materials placed in these areas have served as construction fill for airports, footing for recreational areas and food-control structures or dikes; and for the coarser fraction, as replenishment sands for beach fort restoration. Arguments that favor the use of terrestrial sites as receiving areas for contaminated dredged materials emphasize the combination of containment, the ability to observe closely any negative effects, and relative ease with which corrective actions, such as removal and relocation, could be taken if unacceptable effects are observed.

Counter arguments of upland disposal point to the inherent difficulty of realizing absolute containment of dredged materials. Potential for releases and mobilization of a variety of contaminants can be enhanced by the conditions associated with changes from anaerobic sediments to an aerobic environment. The increased availability of oxygen results in the alteration of the phase of some heavy metals from the insoluble sulfide form (favored in reducing conditions) to more soluble sulfates. In addition, these reactions affect the pH of the interstitial waters to more acidic conditions and the potential for additional release of particulate-bound contaminants. The extent and character of contaminant release resulting from this combination of oxidation reactions varies as a function of redox-potential (Eh) and pH. Increasing Eh and an associated decrease in pH relative to natural in situ values appears to favor release of a progressively wider range of trace metals.

The potential for contaminants release from dredged materials placed in terrestrial sites and the associated probability of surface water or groundwater contamination, as well as increased availability to the local biological community leads to the environmental management of these sites that has to be planned both during and after receipt of contaminated sediments. Effective leachate control presumably can be achieved by the placement of impermeable liners to contain the materials and the use of settling and retention basins sufficient to permit evaporation or effective depuration.

Containment of contaminated or toxic dredged material at an upland disposal site can be an environmentally sound and preferred alternative although it cannot be categorically considered better than other disposal techniques. The environmental effect of upland disposal will vary with the quantity and quality of material to be disposed of, the characteristic of the terrestrial environments, and the availability of sites.

Coincident with the physical and biological variations occurring during and immediately after the disposal operation are a number of chemical processes that affect the distribution and ultimate bioavailability of the variety of organic and inorganic compounds associated with dredged materials. Since many of these materials are known to be potentially toxic, the character and extent of chemical processing typically receives particular attention in efforts to detail the effects of disposed materials. A number of studies, therefore, have to be conducted in order to determine the environmental effects of dredged materials. The general approach used in both laboratory and field studies is to establish a reference or control (station or sample), and to collect some series of pre-project baseline data, and then with the onset of disposal, to initiate analyses comparing disposal-site conditions to those prevailing in the control.

As has been mentioned previously, concerns about dredging and disposal of dredged materials focus on elevated concentrations of selected trace elements, principally cadmium, mercury, and lead, and the synthetic organics, with recent emphasis on polychlorinated biphenyls (PCB) and polynuclear aromatic hydrocarbons (PAH). Laboratory analysis with regard to these constituents in the dredged materials, especially those of the sediments that will be used as landfill can be performed through TCLP (Toxicity Characteristic Leaching Procedure), testing rather than determining the total amount of the constituents. Complete analysis for other constituents will depend on the characteristic and history of the sediments to be dredged. This will need comprehensive environmental study for the area.

3. Ocean Disposal

Prior to passage of the Ocean Dumping Act in the United State of America, procedures for the selection and designation of ocean disposal sites appear haphazard. Positioning and selection of these sites was a simple function of proximity to the project area. Minimizing projects costs favored locating disposal sites close to the dredging project.

The placement of dredged materials in open-water disposal sites has the potential to induce a variety of short-term, acute, and longer-term, chronic environmental effects. The short-term effects are confined to the period of disposal and result primarily from direct burial of marine organisms or their exposure to increased concentrations of suspended materials, trace elements and other contaminants, and nutrients. The majority of these effects can be reduced or eliminated by proper site selection, dredged material disposal techniques, and project timing. Studies of longer-term effects have considered rates of re-colonization and the character of the subsequent biological community, reproductive success, and a variety of sub-lethal effects such as alterations in genetic structure. These effects are by far the most difficult to assess, and consequently, are the least well known.

The sediments suspended during disposal operations have the potential to produce the same range of effects as sediments re-suspended by the operating dredge. Although the potential is greater, the majority of the effects produced by ocean disposal of dredged material are considered negligible, except in areas dominated by sensitive species such as corals, or filter-feeding organisms such as oyster, clams, and mussels. Efforts are generally made in the selection of disposal sites to avoid sensitive areas, including those that support submerged aquatic vegetation and significant concentration of commercially important shellfish.

B. *Ship-waste Reception Facilities*

Beside the general port facilities that are integrated part in a port extension development, in order to prevent marine pollution from ships, ship-waste reception facilities have also to be planned. A fundamental element of the port reception facilities for ship generated waste and cargo residues is the obligation to develop waste reception and handling plans in all ports for the reception and treatment of ships' waste and residues.

The International Convention for the Prevention of Pollution from Ships 1973, and its 1978 Protocol (MARPOL 73/78) aims to regulate and minimize pollution from ships[4]. MARPOL 73/78 covers the five main forms of ship's waste in five specific annexes: (i) oil, (ii) noxious liquid substances carried in bulk, (iii) harmful substances carried in packaged forms, (iv) sewage, and (v) garbage. The directive on port reception facilities has exactly the same objective as MARPOL 73/78, namely, to protect the marine environment. The main features of the directive are:

- Each community port shall have a waste management and handling plan;
- Each community port shall ensure that there are adequate waste reception facilities for vessels normally calling at a port;
- All ships calling at a port must land their ship-generated waste unless they have enough storage capacity for the waste to be delivered at a subsequent port;

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- The cost of the port reception facilities shall be covered through the collection of fees from ships. The amount and the basis on which the fees have been calculated should be made clear for the port users. The fees should be fair, transparent, non-discriminatory and reflect the costs of the facilities and services made available.

Accordingly, many ports have provided some sort of services for ships to dispose of their wastes. However, it is obvious that ship-generated wastes are only part of a port's total waste stream. Nevertheless, there are a number of reasons why the issue of ship-generated waste should not be isolated from the waste handling practices in a port. Ship-generated wastes become a part of the total waste stream of a port, once received on shore. Consequently, both ship-generated wastes and land generated wastes in the port should be handled in an environmentally sound way. Otherwise, actions taken to prevent pollution may merely transfer the problem from the sea to the land or vice versa. For example, if ship-generated waste is dumped on-shore, soil and ground water contamination and risk to human health may result. Examples of land based wastes that may result in water pollution are operational oil spills at terminals, which will have adverse effects unless the spilt oil is properly collected and disposed of.

A second reason is that although the proper management of wastes is expensive, the costs for remedial actions are extremely high and the threat of adverse health and ecological effects is never completely removed. An integrated approach to waste handling that incorporates the entire life cycle of waste (from the moment of generation until its final disposal) may save considerable future expenses. A third important argument is that ship-generated wastes as well as land generated wastes may contain valuable materials, which could be reused. Discarding these wastes is an inefficient use of resources, and recycling options should be explored.

Many of the waste treatment and management systems for land based wastes can be applied for handling ship-generated wastes because of the similarities of both wastes. For example, oily wastes discharged to reception facilities that are usually mixtures of oil, water and solids can be managed and treated in similar way to that those generated by petroleum industries. Although the composition ratio of these wastes (used lubricating oil/ fuel residues, sludge, oily tank washings, oily bilge water, and dirty ballast water) can differ considerably, the prime objective of a treatment technology is to remove oil from water to produce an aqueous effluent which meets the effluent discharge standard. The treatment technology for this waste generally involves three basic treatment method, namely primary (gravity separation), secondary (physical/chemical separation), and tertiary (biological) treatment.

Other ship-generated wastes, such as noxious wastes and garbage could be treated in similar way to the wastes generated in land. Such treatment technology includes biological treatment, chemical oxidation, incineration, recycling, etc. Eventually, the waste management and treatment strategy shall involve the disposal techniques and location of the residues in environmentally safe manner. Studies for proper planning of the ships waste facilities, therefore, have to be conducted in integration with the harbor extension developments. The studies will give information to the authority concerning with the environmental impacts that may arise, how to minimize the negative impacts, how to make planning regarding with the waste management and treatment, and finally how to evaluate the results of the environmental management through proper monitoring plan.

III. REGULATORY ASPECTS

A. *Dredging, Reclamation, and Dredged Material Disposal*

Every project that will be implemented shall fulfill the local government requirement to ensure that the project will not expose any negative environmental impact in the future. This provision for the projects that shall be completed with the environmental studies is described in the Ministerial Decree of Environment No. 17/2001 entitled: "Type of Effort and/or Activities that should be completed with EIA ("*Jenis Rencana Usaha dan/atau Kegiatan yang wajib dilengkapi dengan AMDAL*"). This Ministerial Decree is issued as an implementation guidance following the establishment of the Government Regulation (*Peraturan Pemerintah*), PP.27/1999, describing Environmental Impact Assessment (*Analisis Mengenai Dampak Lingkungan*) [5].

The studied area for dredging operation will produce an estimated dredged materials of 3,395,000 m3. This amount of dredged materials absolutely exceeds the scale limit, which is stated in the regulation that limits 250,000 m3 for capital dredging and 500,000 m3 for maintenance dredging. Besides, the dredging operation will expose environmental impacts in some extent depending on the dredging techniques and the characteristics of the dredging sediments.

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Consequently, the dredging project and its related activities that its scale exceeds the scale limit described by the regulation has to be preceded with the environmental study through EIA/AMDAL prior the implementation of the project. The results of the AMDAL study will ensure the authority that by implementing the environmental management properly stated in the document, there would be no significant impacts to the environment surrounding the projects.

Nevertheless, referring to the available documents, the area being studied where the port extension project is located has been assessed through SEL study. This SEL that was conducted in 1991 is in accordance with the Government Regulation PP 29/1986 (describing Environmental Impact Analysis), Chapter VI, Section 39[6]. The regulation states that the industry that has started the activity before the regulation is in effect (the industry has started the operation in 1971) is not obliged to conduct EIA study. By referring to the guidelines described in the Ministerial Decree of Environment, Kep. 51/MENKLH/6/1987 (Guidelines to Environmental Impact Evaluation Study)[7], in 1991 the industry, therefore, conducted Environmental Evaluation Study (*Studi Evaluasi Lingkungan*, SEL). The SEL that has been conducted by the industry includes all environmental aspect at the industrial area covering the port extension development area that is recently studied. Following the SEL the industry has also established Environmental Management and Monitoring Plan (RKL/RPL) for the processing units that produce urea and ammonia[8].

Referring to PP.27/1999, Chapter I, Section 4, Point (1), it is obvious that the planned project at the studied area, which is located within the sphere that the SEL has been conducted, is not obliged to conduct EIA study any more. The SEL that has been conducted by the industry in 1991 can be prevailed as EIA. Nevertheless, regarding that the Environmental Management and Monitoring Plan (RKL/RPL) established by the industry covers only the processing units that produce urea and ammonia, and considering that the planned project relates to the harbor extension development, it is obvious that the industry should establish additional RKL/RPL for the planned project. This additional RKL/RPL is in accordance with Section 4 Point (2) of PP.27/1999.

Concern about the upland disposal is emphasized on the potential of contaminants release from the dredged materials. This contaminant release will eventually pollute surface water or ground water, as well as increase the contaminant availability to the local biological community. In order to minimize the effects of these contaminants, laboratory studies of the sediments have to be conducted, especially to investigate leaching potential of the contaminant. Recent study conducted in the coastal and sea region around the project indicated a good sea conditions with regard to marine organism and sea water qualities. Nevertheless, this study did not give any detailed information about the sediments beneath the sea water column, especially chemical constituents that are categorized toxic.

Regulations concerning with the upland disposal of the dredged materials can be referred to the Government Regulation of PP 18/1999 jo PP.85/1999[9,10] describing "Management of Hazardous Wastes" and the Ministerial Decree of Environment No.04/1995[11]. These two regulations can be used as guidance in studying the leaching potential of the contaminants through Toxicity Characteristic Leaching Procedure (TCLP) tests, and managing, treating and disposing of materials containing toxic substances. One of suggested techniques in the regulation, for example, is placement of impermeable liners to contain the materials for effective leachate control.

The industry has routinely conducted ocean disposal for maintenance dredged materials in certain place which is located 30 nautical miles away from the coastal line. Nevertheless, since the activities of the extension harbor development project will involve much larger dredged materials to dispose of, study of alternative location for dumping area at sea is worthy conducted for this ocean disposal. Government Regulation, PP. 19/1999[12] that describes "Marine Pollution and/or Damage Control" explains dumping regulation that can be referred to (Chapter VIII, Section 18, Points (1) and (2)).

Several international conventions have been formed to address a variety of issues and problems of ocean dumping. Two of the most influential conventions are the United Nations Convention on the Law of the Sea (UNCLOS) and the London Convention (LC). UNCLOS is considered a strong and effective international treaty because its scope includes a wide range of ocean pollutants and their various sources. The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, known as the London Convention (LC) was put into force on August 30, 1975. The objective of the London Convention is to protect the ocean environment from the risks associated with the unregulated dumping of wastes. It was the first world wide effort of its kind.

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B. *Ship-waste reception facilities*

The provision of reception facilities for ship-generated waste is part of the implementation of the International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 relating there to (MARPOL 73/78). MARPOL 73/78 provisions require the government of each party to ensure the provision of adequate port reception facilities without causing undue delay. A port reception facility is anything which can receive shipboard residues and mixtures containing oil, noxious liquids, or garbage. Type and size of the facility depend on the needs of the ships visiting a port. Where a simple garbage bin and a barrel for waste oil may suffice in a small port, another will need large storage tanks for the reception of residues and mixtures containing oil or noxious liquids.

Failure to establish adequate facilities is a breach of international obligations and will increase the risk of illegal discharges from ships. Where they can, ship operators will favor ports with good services at reasonable cost. In July1994 the International Maritime Organization (IMO) has published a guide concerning with the establishment of port reception facilities for ship-generated wastes. The publication entitled “Comprehensive Manual on Port Reception Facilities” describes in detailed every step in establishing port reception facilities, from developing a waste management strategy, planning reception facilities, treatment facilities, to final disposal[13]. Although the manual does not give detailed engineering guide, it is very useful as a handbook in establishing port reception facilities.

As described previously, the handling and treatment of ship-generated waste should not be isolated from wastes generated by land-based sources. Accordingly, any national regulation concerning with the establishment of waste management and treatment can be referred to as national standard. It has to be noted, however, that the national legislations have to be reviewed prior to the development of complimentary legislation on ship-generated wastes.

The national legislation that can be used as references in establishing port reception facilities is Government Regulation (PP) No.19/1999 describing Pollution and/or Damage Control of Sea. While Ministerial Decree of Environment No. 51/1995[14] describing “Standard Quality of Liquid Waste for the Industries” can be used as a guide for establishing quality effluent discharged by the treatment plants.

IV. CONCLUSIONS AND RECOMMENDATIONS

The harbor extension which will be developed at the area being studied will induce several environmental impacts generated from several activities namely dredging operation, reclamation and dredged material disposal, and establishment of the port reception facilities and other harbor facilities. These environmental impacts can be predicted, and efforts are proceeding to resolve the impacts. Overall, the effects or impacts associated with a proposed project can be reasonably well defined and controlled. Impact prediction and environmental management plan can be developed by conducting an environmental study prior the establishment the project

Referring to PP.27/1999, it is concluded that the planned project at the studied area, which is located within the area that the SEL (*Studi Evaluasi Lingkungan*) has been conducted, is not obliged to conduct EIA/ AMDAL study any more. The SEL that has been conducted by the industry in 1991 can be prevailed as EIA. Regarding that the project scale obviously exceed the scale limit, the UKL/UPL study is not sufficient as guidance for managing and monitoring the environment of the area.

The Environmental Management and Monitoring Plan (RKL/RPL) has been established by the industry. Nevertheless, regarding that RKL/RPL covers only the processing units, while the planned project relates with the harbor development, it is recommended that the industry establishes additional RKL/RPL for that project. This recommended additional RKL/RPL study is in accordance with the Government Regulation, PP.27/1999.

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