

MAMBERAMO NOW



QUARTERLY NEWSLETTER

ENVIRONMENT, INNOVATION, AND DEVELOPMENT OF INTENSIVE ENERGY INDUSTRIES
(E.I.D)

MAMBERAMO RIVER PROJECT

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MAMBERAMO NOW welcomes articles,
commentaries or reviews for publication.

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EDITORIALS

After the first issue of this newsletter, which has attracted many responses and suggestions from our readers, we proudly deliver this second issue.

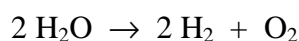
In this second issue, we present some thoughts from interested and concerned parties on the successful of this project. In the first article, Dr. Suharyono briefly describe the proposed high pressure alkaline electrolysis 'pilot plant' by Linde AG of Germany, a worldwide leading company in petrochemicals. In the second one, Dr. Moechtar discusses the opportunity of implementing the new and emerging technology, fuel cell to power transportation system in Mamberamo. While Mr. Sugiyono give some important information on MIC's Web. In this issue we also add a new section, "BRIEFS" which is devoted to every party to describe their related activity and concern on this project. While some sections, such as "What's Next" and "MIC News" remain. Once again, with your support, we believe that this newsletter will visit you regularly in every April, July, October, and January.

Editor-in-Chief

Meirios Moechtar, Ph.D., P.E. ♣

PROPOSED 140 MW HIGH-PRESSURE ALKALINE ELECTROLYSIS PLANT

Electrolysis process that produces H₂ and O₂ from water is one of the potential users of hydroelectric power produced from the Mamberamo River. The chemical reaction of the electrolysis process is:



The H₂ produced can be used for steel reduction, transportation mode equipped by fuel cell and raw material for petrochemical industries. Currently, there are three electrolysis processes that can produce H₂ from water, i.e. alkaline water electrolysis, high temperature water vapor electrolysis and solid polymer electrolyte water electrolysis. Among these three processes, the alkaline water electrolysis is the most advance process. Currently, the alkaline water electrolysis plant is operated in several countries, i.e. Brazil, Canada and Egypt. The other two processes are in R&D stages. The high temperature water vapor electrolysis is performed in Germany, Japan and USA; while, the solid polymer electrolyte water electrolysis is performed in Japan, USA, France and Switzerland. It is expected that the last two processes can operate at a higher efficiency than the alkaline water electrolysis.

In relation with Terms of Reference (TOR) of Environment, Innovation and Development of Energy Intensive Industries (EID) Mamberamo River Project, Linde AG, a German company which is active on the field of Petrochemical, Gas Processing, Air Separation, and Environmental Engineering is interested to perform studies on Mamberamo Electrolysis Plant and on the Utilization of the Natuna CO₂ and Mamberamo H₂ for Petrochemical and Related Downstream Industries. It is expected that these studies can be financed by a grant from German Government. In this conjunction, we already proposed to include this project in the German Indonesian Forum (GIF) meeting on October 1997, in Berlin, Germany.

Electrolysis plant proposed by Linde AG will utilize high-pressure alkaline water electrolysis process. The plan will have a capacity of 140 MW and will constitute of 14000 cells. The cell used is a filter-press type cell housed in a pressure vessel. Each cell, which has an area of 1 square meter, is operated at 6 kA and 1.68 V. This cell can produce 2.5 m³/h H₂. The whole plant can produce about 69 MTD H₂. The process requires 40 wt.% aqueous KOH solution and operates at 30 bar and 140 °C. In this electrolysis process, only water content of the electrolyte is decomposed into H₂ and O₂; while, KOH is not consumed in the process. The water required for the process is deionized water. This process is able to produce H₂ and O₂ at purity of 99.8 mol % and 99.5 mol % respectively. The 100 kW pilot plant constructed at Linde in Höllriegelskreuth have achieved these results.

One of the H₂ utilization considered by Linde AG is as a raw material to produce methanol. In this scenario, H₂ from Mamberamo will be combined with CO₂ from Natuna or from nearby source, Wiriagar. The methanol produced can be utilized as a fuel or as a raw material of its downstream industries.

H. Suharyono, Ph.D. ♣

FUEL CELL WILL POWER TRANSPORTATION SYSTEM IN MAMBERAMO

One of the most important tasks through the 21st century is to ensure a stable supply of energy and maintaining a balanced clean global environment. The principal advantage of fuel cell power plant lies in its favorable environment impact. Fuel cell development is of utmost important in light of the recent worldwide clean air movement.

Fuel cell development started about 30 years ago under the Target Program (Team to Advanced Research for Gas Energy Transportation) in the USA the purpose of which was to develop commercial fuel cell power plants. Since then, a number of larger scale demonstration projects have been

implemented in the USA and Japan. In spite of these efforts, fuel cells still are hampered by high plant cost and unstable operation. Very recently however, via the efforts of manufacturers and users, the operability and cost structure of fuel cell plants have greatly improved.

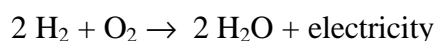
To anticipate and participate in this worldwide efforts of reducing air pollutants, we are very interested in promoting the development and applications of fuel cells in both power plant and transportation systems. One of the prospective sites to promote this technology is in our proposed Environment, Innovation and Development energy intensive industries (E.I.D.) Mamberamo River project in Irian Jaya, Indonesia.

Our proposal is due to the fact that the 600-km long Mamberamo River has a potential to generate between 15 to 20 GW of electricity. This abundant supply of electricity does not only serve the needs for various industrial activities in the area, but also can be used to produce hydrogen, the ultimate fuel for the future, inexpensively. This hydrogen produced from water electrolysis plant can be utilized as fuel for this emerging energy conversion technology, fuel cell.

Advantages of Fuel Cells

The most distinct merit of fuel cells is its intrinsically low emission signature. It permits them to be installed in urban location. The effective utilization of high quality heat generated to produce steam or hot water is another strong feature of fuel cells.

The working principle of fuel cells is essentially the reverse reaction of electrolysis process (see previous article), that is



Fuel cell plants in general have no moving parts and have exceptionally high efficiency even for small capacity range systems. Four types of fuel cells have been under active development worldwide, they are:

1. Phosphoric Acid Fuel Cell (PAFC)
2. Molten Carbonate Fuel Cell (MCFC)
3. Solid Oxide Fuel Cell (SOFC)
4. Polymer Electrolyte Fuel Cell (PEFC)

Among the four types of fuel cells, PAFC is the most advanced to-date and is closest to commercialization in particular in view of the recent demonstrated success in operation stability. The primary advantage of PAFC in comparison to other types is : (1) tolerance to carbon dioxide, and (2) relatively low temperature operation $\sim 200^\circ\text{C}$. However, PEFC that operates at low temperature (80°C) and has very high power density, is very suitable for vehicular applications. A great number of development teams are actively pursuing the development of PEFC systems.

Development of PEFC

PEFC uses proton exchange membrane as electrolyte. Recently PEFC has made tremendous stride due to the availability of high performance membranes. Due to its excellent features : high power density, low working temperature, tolerant to carbon dioxide, PEFC is most suitable for transportation application.

Therefore it is anticipated that PEFC should contribute positively towards the future commercial viability of developing a fuel cell powered vehicle. The effort toward that direction has being conducted worldwide. US-DOE has established a program geared towards the development of PEFC powered vehicle, via the US Fuel Cell Alliance with partners from the Big 3 in Automotive: GM, Chrysler and Ford.

Ballard Power Systems of Canada is the world leader in PEFC development and has demonstrated successfully a PEFC powered bus fueled by hydrogen. On my visit to their facility on July 9, 1997, I have a chance to discuss with Mr. Ken Dircks regarding the prospects of PEFC. Mr. Dircks also mentioned that 6 fuel cell powered buses will be equally delivered to and operated by the transportation authority of city of Vancouver and Chicago. The fuel cell engine, as he called the integrated unit of fuel cell stack, compressor, electric motor to drive the axle and supporting equipment, is about the same size as the regular diesel or natural-gas based engine. The engine is capable of generating 275 HP and drives a 60 passenger bus. Ballard also claimed that their PEFC already succeeded the

minimum requirement on the power density for transportation system. The power density of their PEFC is more than 1000 W/l, while the minimum requirement is about 800 W/l. The range of this bus prototype is 400 km, which is well beyond the average daily requirement.

In Europe, the Daimler-Benz that introduces its first hydrogen-fueled PEFC city bus NEBUS (new electric bus) dominates the work. NEBUS is the fuel cell version of Daimler-Benz's O 405 N model, a 12-meter, low floor city bus with 34 seats plus standing room for 24 straphangers. The fuel cell engine is designed by Ballard, consists of ten 25 kW stacks of 150 individual cells each, providing a total output of about 250 kW (340 HP). Of that total, 190 kW (260 HP) are available for traction, electrical systems and air conditioning. Compressed hydrogen is carried in seven 150-liter, 300 bar roof-mounted gas bottles that hold 45,000 liters. It is sufficient for up to 250 km, that succeeds average daily requirement of 140 to 170 km. Daimler-Benz claims that they will build about 20 of such a bus by the year 2000, in order to get feedback and launch initial worldwide marketing. They estimated the cost of the first prototype bus at about US\$ 1.2 million, but in two years will decrease to about US\$ 470,000.

Role of Fuel Cells in Mamberamo

As indicated earlier, the most attractive key feature of fuel cells is its benign environment impact. The need for a safer and cleaner environment greatly stimulated the development and pre-commercialization of co-generation and vehicular applicable fuel cell plants. Although the largest barriers to successful commercialization are reliability and costs, substantial strides have been made in recent years by fuel cell manufacturers, PEFC is likely to be the forerunner in fuel cell commercialization for transportation system due to its matured status.

The environmentally- friendly, high energy efficiency, and zero emission (when fed with hydrogen) energy conversion device is very suitable to be utilized in transportation sector. However, since this technology is still at its early stage of commercialization in several

industrialized countries, such as Japan and the USA, the implementation of this technology in Indonesia should be conducted in the several stages, such as RD&D, demonstration and commercialization phases.

Therefore, one of the objectives of the study on fuel cell for transportation system must include the assessment and formulation of research, development and industrial activities for the manufacturing of cost effective fuel cells to meet the requirement of transportation system.

M. Moechtar, Ph.D., P.E. ♣

MAMBERAMO RELATED INFORMATION ON THE WEB

Recent advances technology, Internet, make it possible to access information overseas using your personal computer. From your own home or office, you can download data file or information via the Internet.

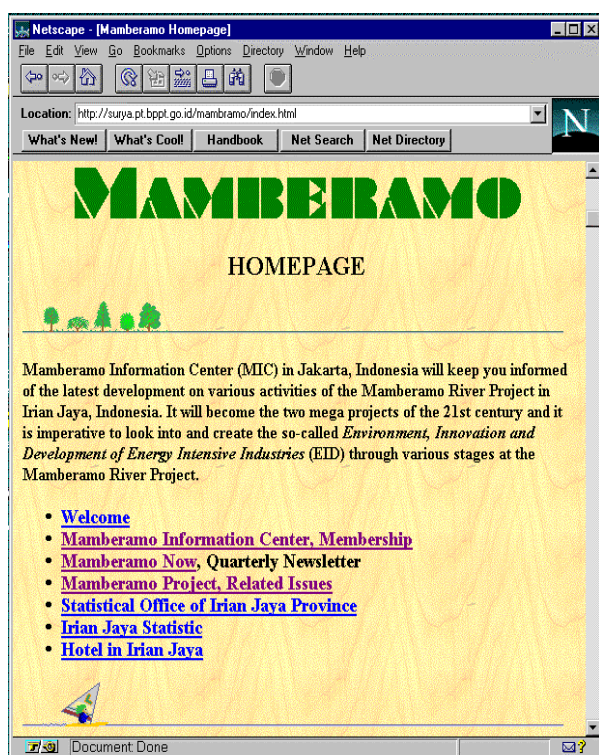
The Internet is a world-wide collection of computers that are linked together. It originated from the project at Department of Defense, USA in the 1960s. The goal of this project was to have a network of computers, which could still operate even in the event of a nuclear war. Later, academics began using it for their research, and then a few years ago it become popular for the general public.

The World Wide Web (WWW or simply the Web) is a way of looking database or information at the Internet's. Using a special type of software called a browser, you can read volumes of text about any topic, watch photographs, artwork, videos and listen to sound clips. The popular browsers are Netscape, Mosaics and Internet Explorer.

Home pages are screens of information on the Web devoted to specific topics. From there, electronic link could be used to view other pages that contain related information. Pages on the Web are reached via electronic address known as Uniform Resource Locators (URLs). For instance the URL <http://surya.pt.bppt.go.id/mambramo> is the address of the home page which contains information about Mamberamo.

Web search engines are specialised programs, which can be used to search the Web for specific information. Net-Search is one of the most popular ways of searching on the Web. For the latest information : <http://home.netscape.com/escapes/search/>. It is important that these electronic addresses must be entered into your browser exactly as they appear here. Don't substitute lower case letters with capital letters and use the same punctuation.

Agus Sugiyono, M.Eng. ♣



MIC NEWS

As most of the MIC members know that the existence of this newsletter is really depend on the annual membership fee, we regretfully have to inform most of the recipients of this newsletter that it may be their last issue. We can only afford to send this necessary and informative quarterly newsletter to our subscribers. Therefore, we invite those who haven't registered yet to do so. The membership due can be submitted as shown at the end of this newsletter.

In addition, to whom that already paid their membership fee, but hasn't send their remittance yet, we really do appreciate if they do so. This is in order to verify our members and thence to serve you better.

Once again, we invite you all to visit our Homepage as shown below. We also would like to invite everybody to submit their thoughts, ideas, comments, etc. to the editor in order to improve this quarterly, and the Mamberamo River Basin Project in General.

BRIEFS

This new section serves as an exchange information among all interested parties on the successful implementation of the E.I.D. Mamberamo River Basin Project. Therefore, we do hope that more individuals and companies as well to submit their related activities on the project, or their intention and interests on the project to the editorial committee of the MIC. By sharing the information, we can expect that everybody will get the mutual benefits, such as performing join effort on certain activity, etc.

In this issue, we will briefly present some topics related to the project development.

BPP Teknologi's Feasibility Study Committee was established

On June 5, 1997, Prof. Dr.-Ing. B.J. Habibie, State Minister for Research and Technology / Chairman of BPP Teknologi signed the Ministerial Decree on the establishment of the feasibility study committee for the development of the Mamberamo River Basin. The committee is chaired by Prof. M.T. Zen former Deputy Chairman for Natural Resources Aessment – BPPT, and currently advisor to the State Minister for Research & Technology. The vice chairmen of the committee are Prof. Dr. Zuhail (former Director General of Electricity and Energy Development) and Prof. Dr. Harijono Djojodihardjo, Deputy Chairman for Technology Development – BPPT. The secretary general is Meirios Moehtar, Ph.D., P.E. There are seven coordinators in this committee to supervise seven activities, such

as mining and metal industries, petrochemical and transportation of CO₂, dam and electricity, agricultural and forestal industries, regional development, social-economic-and-cultural aspect and environmental impact assessment, and engineering design.

A team of expert from several parties also supports the committee. One of them is Ir. A.R. Soehoed of PT. Inalum (Asahan Authority). More experts are expected to join the committee in the near future.

The goals set by this committee during its first brainstorming session, will include preparation of a bankable document based on the results of the feasibility study, identification of the prospective investors, and establishment of working group in executing the project development. One of the strategic ways to achieve this goals is to prioritize a betting horse of the project which will be the prime mover of the project development. The most prospective candidates for the betting horses are aluminum, steel, and titanium industries. The second row will be gold and silver, and copper smelting industries.

Biodiversity of Irian Jaya

Irian Jaya occupies the western half of the New Guinea island, the world's largest and highest tropical island. As presented by the Conservation International (CI), in cooperation with Bappeda Tk. I Irian Jaya, University of Cendrawasih, LIPI and PHPA, Irian Jaya might have 20-25,000 species of vascular plants. It also has at least 164 species of mammals, 329 reptiles and amphibians, some 650 birds, about 250 freshwater and 1200 marine fishes, estimated 150,000 insects, and many hundreds of other freshwater and marine invertebrates. Thus, Irian Jaya itself contains almost one half of the Indonesia's total biodiversity. This results that Indonesia now appears to be the number one biodiversity country in the world, surpassing Brazil and Columbia, as quoted by Dr. Jatna Supriatna of CI Indonesia.

Yet it is among the least studied areas in the Asia-Pacific region. Both biological and socio-economic research in this area has been very limited; consequently, there is much that we

do not understand about the people (over 250 ethnic groups live in Irian Jaya), flora, and fauna of this Indonesian easternmost province.

We need to include this aspect in our preparation for the Mamberamo river basin project as it will occupy an area of about 100,000 km² of the total Irian Jaya area of 416,000 km². In doing so, we will include almost every conceivable aspect in the project development, such as mining and metal industries, petrochemical industry and transportation of CO₂, dam and electricity, agricultural and forestal industries, regional development, social-economic-and-cultural aspects and environmental impact assessment, and the latest biodiversity conservation.

Mappings and GIS

In order to develop an area, especially the one of the size as large as the Mamberamo river catchment area, we surely will need many supporting information and data, such as topological, geological, hydrological, social, cultural, biological, and so on. Conducting some aerial mappings, interpretation of satellite images, and ground checking can provide some of them.

In this conjunction, so far there are two Indonesian companies that already showed their interests and presented their activities to the Mamberamo project team members from BPP Teknologi. One of them is PT. Tata Guna Patria, a consulting company that has done many works for the Department of Public Works. This company already did some mappings and ground surveys of most of the Mamberamo area. The second one is PT. Mapindo Parama, a subsidiary of Mapindo (Indonesian Forestry Society), which is the major player on many forestal related activities in Indonesia.

The first company already collected many preliminary studies and surveys on the area, from hydropower potential to the he initial social economic assessment of the area. While the second one emphasis their activity on providing aerial maps of 1:20000 and 1:25000. It may be worth it to contact and utilize their resources for any interested parties.

CO2 Fixation and Utilization

In March 1997, Prof. Harijono Djodihardjo and Dr. Meirios Moechtar of BPPT visited Tokyo, Japan. During that visit, they met Mr. Tanaka of NEDO, an agency under MITI and Messrs. Maruyama and Maezawa of RITE (Research Institute of Innovative Technology for the Earth), an agency responsible on the environmental-related studies and fixation. In that short meeting, all parties are agreed to continue their cooperation by sharing all the necessary information on the related study on the fixation and utilization of CO2.

As some readers may know that another project proposed by State Minister of Research and Technology is Natuna Gas Field in South China Sea. Of the total 212 TCF gas, more than 70% of its content is gas CO2. While we have abundant of inexpensive and environmentally-friendly electricity in Mamberamo, it is concurrently that Prof. Habibie proposed an integrated approach to both projects.

In continuing our join effort, starting this year we already started exchange information on Natuna and Mamberamo projects schemes. The second meeting on this project is hopefully can be done sometime this year in Jakarta, Indonesia. During this meeting, some visits to either Natuna island, any methanol industry, and possibly to Irian Jaya are expected in order to gather more relevant issue on the join study.

Visit to Jayapura, Irian Jaya

In the mid of last June, a team consists of personals from BPPT, Dep. of Public Works and consulting company (representative from JICA – Japan couldn't make it due the shortage of time in obtaining the security clearance) visited Jayapura, Irian Jaya. In that visit, we presented several aspects of project implementation to the Regional Development Planning Board, The District Government of Jayapura, Regional Office of Public Works, and Branch Office of the State Electric Co. (PT. PLN).

We rated this visit as a 20/20 mission as we received very positive and constructive response from our guests. The team members

are very glad with the results of this visit, and every party agreed to meet regularly such that a better coordination can be achieved. The local government and private parties now understand about their roles and what they can do in supporting this project, includes the preparation and development of the local human resources. It is also preliminarily agreed to assigned the Waropen Atas area as the prospective Industrial Estate candidate. This is due to its strategic and potential location for ocean harbor and its proximity to the potential hydro power plants. The next visit will be sometime in September this year.

Construction and Consulting

Many companies already showed their interests in the engineering consulting and construction works of the projects. They represent many worldwide class construction and engineering consulting companies. Some of them are JGC Corp. of Japan, Meyer Structural Engineering of Germany, Borkalis International of the Netherlands, Geosurvey of Belgium, and many others companies.

Other Activities

In this fiscal year, some directorates in BPP Teknologi already started some preliminary studies and industrial identification surveys. For example, our energy team visited the facility of the PT. INCO (Indonesian Nickel Company) to identify the prospect of nickel smelting industry in Mamberamo. The team also visited steel industry, petrochemical industry, and some research institutions at the Institute of Technology – Bandung and University of Gajah Mada, Yogyakarta. Both are related to fuel cell and electrolysis technologies. They will visit some other industries such as aluminum smelting in Asahan, North Sumatera, methanol in Bontang, petrochemical in Cilegon, etc. in the coming months.

While the agricultural team continued their survey in the Mamberamo area. This team has been doing their activity in the last three years. Other new comers in this project are the teams in the field of regional development, transportation system and environmental

impact assessment. They represent two directorates under BPPT.

WHAT’S NEXT

GIF III in Berlin, Germany

The GIF III will be held in Berlin, Germany in October 1997. In this meeting, the Mamberamo team already requested the Indonesian Committee to include Mamberamo project in one of the agenda of the meeting. While from the German industries, some of them already showed their interest to attend the meeting, and if possible to present their ideas on the Mamberamo river project development. In this conjunction, any necessary measures have been performed in order to optimally utilize this meeting.

Indonesian Institution of Engineers (PII) and Australian Institution of Engineers (IEAust) Joint Conference

We tentatively set a joint conference between PII and Australian Institution of Engineers on the development of the East Region of Indonesia (Kawasan Timur Indonesia – KTI) in September 1997. Since Mamberamo is located in that region, so the Mamberamo project team already requested the organizing committee of the conference to include this project in one of the meeting agenda.

MIC MEMBERSHIP 1997

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Name	Institution
Yan Pieter Karafir	Pemda Tingkat II, Jayapura
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