

TECHNICAL DUE DILIGENCE

MSAR PROJECT, LITHUANIA

PHASE 1 APPRAISAL

(Commercial Demonstration at
Mazeikiu Nafta Refinery)

Prepared for: -

EUROPEAN BANK
FOR
RECONSTRUCTION AND DEVELOPMENT



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Executive Summary

Quadrise Fuels International (QFI) has requested loan finance from the European Bank for Reconstruction and Development (EBRD) for a project to be constructed to produce and use Multiphase Superfine Atomised Residue (MSAR) fuel on a full commercial capacity scale in Lithuania. A Commercial Demonstration (CD) to produce and use MSAR on a limited capacity scale was undertaken in Lithuania, involving manufacture of over 20,000 tonnes of MSAR fuel at the Mazeikiu Nafta refinery, followed by transportation of the fuel some 300 km by rail and use of the fuel in the Lietuvos Elektrine power station, at Elektrenai in Lithuania.

This report presents the results of part of the first phase of technical due diligence, and reviews the commercial demonstration results - and other information available - concerning MSAR production at the Mazeikiu Nafta refinery.

The Project

There will be the opportunity to manufacture MSAR fuel on a full-scale capacity basis at the Mazeikiu Nafta refinery in Lithuania, and to supply this fuel to the Lietuvos Elektrine power station starting around the 4th Quarter of year 2009.

The design capacity of the full scale MSAR Manufacturing Plant (MMP) to be actually installed at the refinery would depend on several factors. Most importantly would be the amount of heavy residue feedstock that the refinery could commit to supplying to the MMP.

It is expected that the refinery will continue to process similar quality crude oils to the current crude diet, which is predominantly Russian crude oils from the Urals region. These are similar to the original design, and form the majority of the current crude oil feeds and the refinery configuration is suited to such feedstocks. However other crude oils have been and are being assessed by the refinery due to the risk of supply interruptions from Russia.

Additionally, the refinery is in the process of implementing a major upgrading and modernisation programme which when completed will have the effect of increasing production of distillate products (such as gasoline and diesel) and reducing production of heavy residue streams, such as heavy fuel oil. The refinery's own on-site power station is also planning to start consuming residue-based fuel from 2011 onwards.

Such factors indicate that, in the initial years of operation, larger quantities of heavy residue feedstock could be available as feedstock for MSAR production than in the later years, after the refinery has been upgraded. It may be possible however to source additional volumes of refinery residue from other refineries in the region.

QFI (the Sponsor) have concluded, as an initial basis, that the MMP could consist of up to five 40 metric tonnes per hour (of MSAR production capacity) manufacturing modules, giving a total of up to 200 metric tonnes per hour maximum MSAR production capacity, which would ensure adequate overcapacity margin to cover potential production outages due to unforeseen operational problems.

The Sponsor

The Sponsor for this project is Quadrise Fuels International (QFI), a public British Company with shares traded on the AIM market in London. QFI has an agreement with AkzoNobel to

use AkzoNobel's licensed technology for MSAR projects such as this proposed in Lithuania.

The capability of QFI comes from the agreement with Akzo Nobel and from the in-depth relevant expertise of QFI's personnel, particularly their previous experience in the Orimulsion business. Key QFI personnel have also previously held senior positions in major oil companies such as British Petroleum and Shell, and in international engineering and project management companies such as Foster Wheeler. While a small company in terms of the number of its personnel, QFI operates on an outsourced business model managed by core technical specialists.

No unacceptable technical risk has been identified arising from QFI undertaking the sponsorship to complete this MSAR manufacturing plant project in Lithuania.

The Licensor and the Licensed Technology

Central to Akzo Nobel's licensed technology is the variable speed motor driven Colloid Mill, which produces the desired emulsified product. The licensor has accumulated a wealth of experience in applications utilising Colloid Mills to produce emulsions. Over 100 plants have been sold worldwide to manufacture bitumen emulsions for road asphalt applications alone. For this MSAR fuel emulsion application, varying heavy oil/water/chemical formulations would be used depending on the quality of the heavy oil feedstock but that is not assessed as being unduly different or unproven technology.

There is not a scale up problem, as multiple standard capacity skid mounted modules would be used in parallel operation in order to achieve the overall throughput required. The Licensor's past experience of bitumen emulsion plants ensures that high quality metals, such as stainless steels, are used where necessary to avoid corrosion risks.

Emulsion stability is a key element of this application and the licensor has devoted much research to determining suitable product formulations to achieve the required degree of emulsion stability.

It is assessed that there is no unacceptable technical risk from using the AkzoNobel licensed technology for this MSAR manufacturing plant project in Lithuania. This assessment is substantiated by the CD results.

The Commercial Demonstration of MSAR Production

To demonstrate the operational viability and robustness of MSAR manufacture, transportation and combustion, a Commercial Demonstration (CD) was carried out. This demonstration involved the manufacture of some 23,000 tonnes of MSAR at the Mazeikiu Nafta refinery during June - September 2008, and for the transfer of some 20,000 tonnes of MSAR for consumption at the Lietuvos Elektrine power station during September 2008. The remaining 3,000 tonnes of MSAR, a result of storage tank ullage, were blended back into heavy fuel oil.

QFI's comprehensive report concluded that the MSAR commercial demonstration was a success for all the parties concerned and that the specifications of MSAR fuel delivered to Lietuvos Elektrine were similar to or superior to Orimulsion. During the period the refinery processed a blend of up to 50% Volve crude along with the normal slate of Urals crudes with no significant influence on the quality of the resulting MSAR fuel produced.

QFI's main objectives from the commercial demonstration were reported to be fully achieved.

A temporary MSAR production system was integrated within the refinery environment to produce commercial quantities of stable emulsion fuel. The MSAR production system could be operated continuously on a 24/7 basis. MSAR fuel could be produced and exported from the refinery alongside conventional heavy fuel oil product (Mazut) using existing dispatch infrastructure. MSAR fuel performance was deemed by Lietuvos Elektrine to be similar to, or in many cases better than, the Orimulsion fuel from Venezuela.

If commissioning of the proposed full capacity commercial facility is to commence in 4th Quarter 2009, QFI's report recommends that the respective parties should proceed with discussions and conclude framework agreements for future MSAR production at the earliest opportunity.

There were a number of lessons learned by the parties concerned after this commercial demonstration. However the technology licensor (Akzo Nobel), the Sponsor (QFI), the Mazeikiu Nafta Refinery and the Lietuvos Elektrine power station were all satisfied that it was a successful demonstration of MSAR production.

No unacceptable technical risk has been identified from this review of advice and reports available for the Commercial Demonstration of MSAR production at the Mazeikiu Nafta Refinery in Lithuania.

The Mazeikiu Nafta Refinery in Lithuania

This large capacity oil refinery was originally put into operation in 1980, and has undergone many additions and upgrading projects since. Originally crude oil supply was entirely by pipeline from the former Soviet Union (now from Russia). But the refinery is well aware of the risk of interruptions in this supply from Russia, and is diversifying its crude oil supplies by importing overseas crude oils via crude oil terminals on the coast such as at Butinge, and then via the existing crude oil pipeline to the refinery. Qualities of imported crude oils have to be suitable for the refinery configuration of process units, but this is not causing any operational problem as the refinery has the use of sophisticated crude oil planning software (PIMS).

The refinery has been under new ownership since 2006 and the new ownership is contemplating major modernisation investment over the next five years. Addition of a new hydrocracker complex would reduce the quantity of heavy oil feedstock available for MSAR production, but completion of this new hydrocracker complex is estimated to take at least five years to complete. Environmental matters are addressed in a reasonably up to date manner by the refinery staff and there is in place an Environmental Management System, which they aim to have certified to international standards. MSAR production at the refinery will not materially impact on refinery emissions to the local environment.

It is assessed that there is no unacceptable technical risk by locating the MSAR Manufacturing Plant at the Mazeikiu Nafta Refinery in Lithuania.

Conclusion

It is concluded that the MSAR production technology is essentially proven, and that any further technology developments would only be to make emulsion formulation adjustments to allow for variations in heavy oil feedstock quality and that the technology licensor (AkzoNobel) is fully capable of determining such formulation adjustments.

1 Introduction

1.1 Background

Quadrise Fuels International (QFI) has requested loan finance from the European Bank for Reconstruction and Development (EBRD) for a project to produce and use Multiphase Superfine Atomised Residue (MSAR) fuel on a full commercial capacity scale in Lithuania. A Commercial Demonstration (CD) to produce and use MSAR on a limited capacity scale was undertaken in Lithuania, involving manufacture of about 20,000 tonnes of MSAR fuel at the Mazeikiu Nafta refinery, followed by transportation of the fuel some 300 km by rail and use of the fuel in the Lietuvos Elektrine power station.

As part of their project evaluation, EBRD are commissioning technical due diligence in two phases. This following study report presents the results of part of the first phase of technical due diligence (Phase 1), and reviews the commercial demonstration results and other information that is available concerning MSAR production at the Mazeikiu Nafta refinery. A separate Phase 1 study report (prepared by JR Sturgeon) will review the demonstration of MSAR combustion at the Lietuvos Elektrine power station.

The overall purpose of the Phase 1 technical due diligence is to discover any actual or potential problems with the use of MSAR technology for this project. The second phase of technical due diligence (Phase 2) will be contingent upon EBRD deciding to proceed with Phase 2 due diligence after considering the results of the Phase 1 study.

A Career Summary of the author is detailed in the Appendices.

1.2 Objective

As described in EBRD's Terms of Reference document, the objective of the Phase 1 technical due diligence study is to determine whether there are any fundamental risks associated with the project which would make it unsuitable for loan finance, e.g. technology development risk.

Therefore this report reviews and provides an assessment of the technology involved. A critical element of this is to provide an opinion as to whether the process utilises proven technology or the extent to which there are technology development risks involved.

The second and separate Phase 1 study report will assess the demonstration of MSAR combustion at the Lietuvos Elektrine power station, and report on any technical development risks regarding that operation.

1.3 Scope

The scope of this part of the Phase 1 technical due diligence study work, as described in EBRD's Terms of Reference document, is summarised below.

- (a) Review the prior experience of QFI, the Project Sponsor, and provide an opinion on their competence to successfully complete the project. (See Section 3 below)
- (b) Review the Commercial Demonstration report for the MSAR

production plant and the results obtained during the Commercial Demonstration. (See Section 5 below)

- (c) Describe crude sources and products from the Mazeikiu Nafta refinery, and review potential limitations relative to refinery current and planned future configurations and potential sourcing of crude. Provide an opinion on the risks related to possible change of residue quality/characteristics and what consequences this may have on the MSAR production plant equipment and on the quality of final MSAR product. (See Sections 5 and 6)
- (d) Describe the technology and equipment used for MSAR fuel preparation and review if there could be potential scale up problems. (See Sections 4 and 5 below)
- (e) Report any known or potential problems such as corrosion, emulsion stability, MSAR fuel characteristics, and consider operations during summer and winter extremes of ambient conditions. (See Sections 4 and 5 below)
- (f) Provide a summary of this Preliminary Appraisal with assessment of whether the technology is proven and if there are any potential technology risks involved. (See Section 7 below)

1.4 Schedule

EBRD suggested that for Phase 1 the due diligence consultants should visit the sites for both the refinery and the power station while the commercial demonstration was in operation. Further information would be gathered by desk research.

An inception meeting between EBRD, QFI and the author was held in London on 26th August 2008, just before the site visit to the refinery. Then on 27th August 2008, a one-day visit was made to Mazeikiu Nafta refinery by the author to observe the refinery layout and location and the demonstration MSAR production plant in operation, and to hold a brief discussion with the refinery's Deputy General Director for Production. During the visit to the refinery, personal contact was made with the representative of Akzo Nobel (the process licensor), which facilitated obtaining relevant information about their company and the MSAR production process technology.

It was intended that the results of this part of the Phase 1 due diligence study would be presented to EBRD in a draft report in English (3 copies) within approximately 1 month of the inception meeting (although this did in fact depend on the availability of other commercial demonstration reports) and that the final report would be issued within approximately one week of receiving comments from EBRD.

2.0 The Project

As outlined above, and subject to a successful commercial demonstration and contractual agreements being executed by the parties involved, there will be the opportunity to manufacture MSAR fuel on a full scale capacity basis at the Mazeikiu Nafta refinery in Lithuania, and to supply this fuel to the Lietuvos Elektrine power station (also in Lithuania) starting approximately in the 4th Quarter of year 2009. The MSAR fuel produced at the refinery would be transported by rail to the Lietuvos Elektrine power station via the national railway system, which is operated and controlled by the Lithuanian Railways (AB Lietuvos Geležinkeliai), over a distance of approximately 300 kms.

The design capacity of the full scale MSAR Manufacturing Plant (MMP) to be actually installed at the refinery would depend on several factors. Most importantly would be the amount of heavy residue feedstock that the refinery could commit to supplying to the MMP. This would in turn depend on the refinery's operating crude oil capacity, the nature of the crude oils being processed and the extent to which the refinery converts lower value heavy residue streams to more valuable distillate products such as gasoline and diesel.

It is expected that the refinery will continue to process similar quality crude oils to the current crude diet, which is predominantly Russian crude oils from the Urals region. These are similar to the original design, and are the majority of the current crude oil feeds and the refinery configuration will be suited to such feedstocks. However other crude oils have been and are being assessed by the refinery due to the risk of supply interruptions from Russia. Additionally, the refinery is in the process of implementing a major upgrading and modernisation programme which when completed will have the effect of increasing production of distillate products (such as gasoline and diesel) and reducing production of heavy residue streams, such as heavy fuel oil. The refinery's own on-site power station will also start to consume residue based heavy fuel oil from about the year 2011 onwards. Such factors indicate that, in the initial years of operation, larger quantities of heavy residue feedstock could be available as feedstock for MSAR production than in the later years, after the refinery has been upgraded. It may be possible however to source additional volumes of refinery residue from other refineries in the region.

Another factor which could impact on the capacity of the MMP would be the amount of MSAR that the Lietuvos Elektrine power station could commit to purchase. It may be that more MSAR could be supplied to the power station initially, but less later after the refinery residue net production quantities will have decreased.

QFI (the Sponsor) have concluded, as an initial basis, that the MMP should consist of up to five 40 metric tonnes per hour (of MSAR production capacity) manufacturing modules, giving a total of up to 200 metric tonnes per hour maximum MSAR production capacity, which would ensure adequate an overcapacity margin to cover potential production outages due to unforeseen operational problems.

The refinery and the Lithuanian Railway system are well capable of moving such tonnages of MSAR (or heavy fuel oils) from the refinery. In 2006, production records show that the heavy fuel oil production from the refinery amounted to 1.8 million tonnes.

The MSAR Manufacturing Plant would be sited at a suitable location within the Mazeikiu Nafta refinery, suitably positioned to receive the design residue based heavy oil feedstock and to discharge the MSAR emulsion fuel product to dedicated storage tank(s) close to the black oil railway loading facilities. The refinery would undertake to supply the required full range

of support utilities and services such as power, water and instrument air, and to provide suitable plot space for all the necessary processing and control facilities.

3.0 The Sponsor

Quadrise Fuels International (QFI)

The following section is based on information provided by QFI about their resources and personnel. Several of the QFI personnel are known to the author, who has no reason to doubt the accuracy of the information given below.

3.1 Formation of the Company

The origins of Quadrise Fuels International (QFI) lie in a group of former British Petroleum (BP) specialists. In the 1980's BP and PDVSA, the national oil company of Venezuela, announced the development of a new process that converted bitumen from the Orinoco basin in southern Venezuela to an oil in water emulsion fuel that could be burned in commercial power boilers. The new product, Orimulsion®, was used worldwide as a power generation fuel with a consumption exceeding 6 million tonnes per annum. Worldwide some 60 million tonnes of Orimulsion were consumed before production ceased in December 2006 under instruction of the Venezuelan government.

Development of MSAR® (Multiphase Superfine Atomised Residue), an advanced emulsion fuel, was initiated in the early 1990's when BP exited the Orimulsion® business. Quadrise Limited (QL) was formed by senior BP members of the original Orimulsion® commercial and technical team and took previous concepts and developed them to produce MSAR®, a more flexible fuel with superior combustion characteristics. This work was undertaken in conjunction with Akzo Nobel. In 2006 QL was incorporated into QFI, which now trades on the AIM market in London.

3.2 QFI Resources and Capability

QFI resources and capability stem from two sources, the expertise of their personnel and their agreement with Akzo Nobel.

3.2.1 Personnel Expertise

Members of the original Orimulsion team and founders of QL are significant shareholders in the QFI business and continue to perform work for QFI. These people have been supplemented by additional staff who were actively involved in the development, manufacture, marketing and application of Orimulsion, plus experienced staff with many years experience in the engineering and construction industry. Areas of expertise are summarised below, and CVs included in 3.2.4 below.

Project management and development

B Howe, L Christie, J Miles

Emulsion fuel production and utilisation

Dr S Craige, J Miles, Dr A Stockwell, P Gunter

Refinery optimisation and process design

Dr I Duckels, A P Kallis, L R Christie

Economic analysis and logistics management

J Miles, I Hole

Environmental impact management and quality control

J Miles, P Gunter, Dr S Craige

It is the author's view that the personnel resource available to QFI is of an extremely high standard and has particularly relevant expertise in emulsion manufacture, quality control, transportation, relevant environmental matters and application of the fuel at the point of combustion.

The QFI team also has very experienced personnel with prior experience of developing projects of greater complexity and magnitude than required for the Lithuanian project, which should ensure a smooth and timely project execution.

3.2.2 Akzo Nobel Agreement

QFI has an evergreen Alliance Agreement with Akzo Nobel Surface Chemicals for use of that company's technology for production of emulsion fuels with a minimum term up to December 2011. Akzo are one of the foremost companies operating in the surface chemistry field and have the expertise for production of stable emulsions from a wide variety of feedstocks subjected to varying parameters of transportation, handling and storage.

The 'Alliance' nature of the agreement with Akzo is structured to ensure co-operative development of the technology on projects and for new markets. Akzo and QFI have a mutual interdependence in respect of a successful outcome for the business as each party brings different skills sets to project development.

Akzo provide the following to QFI in terms of the Alliance Agreement:

- Residue characterisation
- Pre-contract emulsion formulation and testing
- Field test support – personnel and equipment
- Specialist chemicals
- Proprietary equipment (emulsion mill)
- After sales support – new formulations etc

3.2.3 Corporate Organisation

QFI's corporate organisation is depicted in the chart below. QFI operates on an outsourced business model managed by core technical specialists

The company has an experienced Board of Directors with long experience in the oil and financial sectors.

All together the company has 5 personnel with prior experience of Orimulsion fuel.

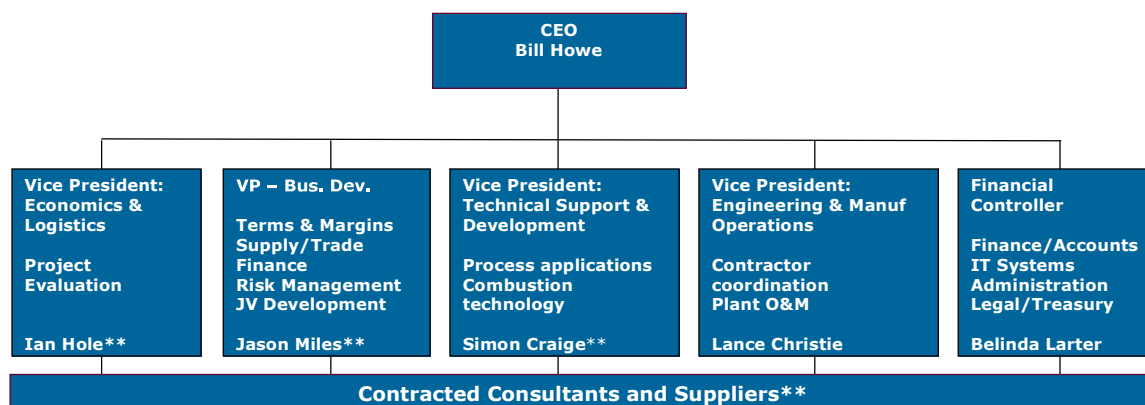
Board of Directors

EXECUTIVE

Chairman	Ian Williams
Chief Executive Officer	Bill Howe
Financial Director	Hemant Thanawala
Director – Bus. Dev.	Jason Miles

NON-EXECUTIVE

Tony Lowrie & Laurie Mutch



** former BP/PDVSA Employees actively associated with Orimulsion (7 total)

3.2.4 Personnel CVs

CVs of QFI's key staff and consultants are provided below.

Bill Howe, Chief Executive Officer

Bill Howe began his career as a process engineer in the hydrocarbon processing industry and joined Foster Wheeler in 1975. At Foster Wheeler, Bill was closely associated with the oil, gas, refining and power sectors, and held a number of senior executive positions including MD of its South African affiliate, as a main board member of Foster Wheeler Energy Ltd (UK), Senior VP of Foster Wheeler Power Systems Europe and as a member of the international Sales and Technology committees of Foster Wheeler International Corporation. Bill subsequently joined Bateman Project Holdings Limited in 1999 as Executive Director responsible worldwide for the company's oil, gas, energy and water engineering businesses. Bill has a BSc Hons in Chemical Engineering from the University of Birmingham, UK.

Jason Miles, Vice President and Director - Business Development

Jason Miles started his career as a process engineer for British Petroleum (BP) in London. In 1992 he was seconded to the joint venture with Petroleos De Venezuela SA that established the market for Orimulsion®. He has over 10 years of specialist technical, environmental and commercial product knowledge in the use and competitiveness of emulsion fuel for power generation. Prior to QFI in 2006 he was a Senior Oil Consultant for OpenLink for two years. Jason has a BEng Hons in Chemical Engineering from Loughborough University, an Executive MBA with distinction from Cass Business School (City of London) and is a chartered chemical engineer (MIChemE).

Lance Christie, Vice President - Engineering & Manufacture

Since graduating in Chemical Engineering in 1984 Lance has accumulated 22 years of experience as a Process Engineer, Project Engineer, Engineering Manager and Project Manager in Process Plant Design and Engineering in the fields of Refining, Petrochemicals, Oil & Gas processing, Synthesis Gas processing, and Utility & Offsite design. Experience includes 4 years as Technical Manager for Foster Wheeler Malaysia from 1998 to 2002 and Manager of the Process Department of Foster Wheeler South Africa, 1995 to 1996. Responsibilities included management, planning, quality control, personnel selection, resource allocation, proposal development and project estimation.

Dr Simon Craige, Vice President - Technical Services

Simon Craige holds a BSc in Applied Chemistry and a PhD in Bitumen Technology. He has expert specialised knowledge of emulsion science combined with commercial application experience and a substantial understanding of power generation technology and related engineering. Dr Craige was part of the British Petroleum Research Centre team involved in the development of the specialised technology supporting the Orimulsion[®] venture with Petroleos De Venezuela SA in the late 1980s. Transferring to the joint venture, he worked extensively in Europe co-ordinating major developments associated with the conversion of thermal power stations to emulsion fuels. He joined Quadrise mid 2005, following a three-year term as managing director of a Danish oil re-refining company, DOG A/S.

Ian Hole, Vice President - Economics and Logistics

Ian Hole has worked in the energy industry for over 25 years including more than 10 years in the field of emulsified fuels and has an MA in economics from Cambridge University. Ian held a number of roles within the British Petroleum group and worked on the establishment of its joint venture with Petroleos De Venezuela SA to market Orimulsion[®]. He then worked for the joint venture and subsequently transferred to Petroleos De Venezuela SA with responsibility for commercial development. In 2000 he joined former British Petroleum colleagues as a director of Quadrise Ltd specifically to develop the Quadrise MSAR[®] fuel initiative.

Tony Kallis, Consultant

Tony Kallis is a chemical engineer with over 34 years experience in the oil and energy field. He spent 30 years with the Royal Dutch/Shell Group, during which time he progressed from refinery technology and optimisation activities, to supply and distribution functions and finally to marketing and senior general management. Mr Kallis held various senior management and board positions within Shell Group companies, including that of chairman of several subsidiary and joint venture boards in Southern Africa. From 1997 to 1999 Mr Kallis worked as a Global Leadership Consultant within the Shell group, leading substantial programmes in South East Asia. Recent roles at Shell included commercial business responsibility for Southern Africa, as well as membership of global teams responsible for formulating strategy for downstream oil business sectors. Tony was Commercial Director of QFI between 2006 and February 2008, returning to Cape Town for personal reasons, but continuing as an active QFI team member on a consulting basis.

Dr Ian Duckels, Consultant

Ian Duckels has over 30 years' experience in the oil, chemicals and mining industries, having worked for both Shell and the British Petroleum groups, including his involvement in the establishment of British Petroleum's Nerefco refinery in Rotterdam as first Chairman of the management board. He has a BSc in Chemistry, a PhD in Chemical Physics, a BSc in Mathematics & Astrophysics and is an associate of the Chartered Institute of Management Accountants.

Dr Alan Stockwell, Consultant

Alan Stockwell jointly founded Quadrise in the early 1990s. Prior to that, he worked for the British Petroleum Research & Development for over 15 years, leading the emulsion technology team responsible for the development of Orimulsion®. Dr Stockwell also served as a key member of the team that developed Transoil, a product used for the transportation of Wolf Lake bitumen in emulsion form. He has played a key role in the development of MSAR® with Quadrise and is a director of Wildfire Energy consultancy. Dr Stockwell has a BSc in Chemistry and a PhD in Physical Chemistry.

Paul Gunter, Consultant

Paul joined BP Research in 1985 as part of the team developing emulsification technology for utilisation of heavy oils/ bitumen in Canada and Venezuela. This collaborative research programme with Intevep led to successful field trials with TRANSOIL in Canada and the development of Orimulsion®. Subsequently he joined the European affiliate responsible for marketing Orimulsion® in 1992, focusing on fuel quality and spill / licensing issues and working closely with PDVSA, clients, regulators and government agencies. In 2003 he joined OSRL as Principal Consultant, the oil industry's global oil spill response facility since 1985, responsible for co-ordination of departmental activities and managing the day-to-day activities of the OSRL consultancy team and Singapore projects. In July 2006 he joined Wildfire Energy as Principal Consultant.

3.3 Technical Appraisal of Quadrise Fuels International – The Sponsor

- The Sponsor (QFI) has an agreement with Akzo Nobel (The Licensor) covering the use of AkzoNobel's licensed technology for MSAR projects such as this proposed in Lithuania.
- The capability of QFI comes from this agreement with AkzoNobel and from the in-depth relevant expertise of QFI's personnel, particularly their experience in the Orimulsion business, an oil in water emulsion fuel that could be fired in commercial power boilers.
- QFI personnel have previously held senior positions in major oil companies such as British Petroleum and Shell, and in engineering and project management companies such as Foster Wheeler. Their experience with such companies would enable them to manage the development of this Lithuanian project, which would be relatively small in investment cost terms compared with high capital cost projects with which they have had experience.
- Although a relatively small company in terms of the number of its personnel,

QFI operates on an outsourced business model managed by core technical specialists. If a number of engineering and construction contractors are to be engaged on this project, it might be necessary for QFI to either expand its permanent staff numbers, or to employ a project management company, to oversee and monitor such contractors.

In summary, it is assessed that there is no unacceptable technical risk from QFI undertaking the sponsorship of this MSAR manufacturing plant project in Lithuania.

4 The Licensor and the Licensed Technology

The following is based on information provided by the Licensor (Akzo Nobel Surface Chemistry AB) to describe the evolution and current status of Akzo Nobel's emulsification technology. During the visit to Lithuania to attend the MSAR commercial demonstration, some key Akzo Nobel employees were met by the author, who has no reason to doubt the accuracy of the information given below.

4.1 The Company – Akzo Nobel

The MSAR production plant would utilise the licensed technology of Akzo Nobel Surface Chemistry AB (the Licensor), a Swedish Company located at Stenungsund in Sweden. This company is a subsidiary company of Akzo Nobel, a Fortune Global 500 company based in the Netherlands and which is listed on the Euronext Amsterdam stock exchange.

In January 2008, Akzo Nobel acquired Imperial Chemical Industries (ICI) of the UK. In 2007 the revenue of Akzo Nobel (plus ICI) was € 14.4 billion and there were around 60,000 employees worldwide (Akzo Nobel plus ICI).

Akzo Nobel Surface Chemistry AB is the European entity of the business unit "Surface Chemistry". Akzo Nobel Surface Chemistry is a leading supplier of speciality surfactants and polymers to a wide range of industries including asphalt, mining, petroleum and other industrial applications.

The Akzo Nobel worldwide organisation covers three main Business Areas i.e. Decorative Paints, Performance Coatings and Speciality Chemicals. The Surface Chemistry business unit operates within the Speciality Chemicals Business Area.

4.2 Fuel Emulsion Technology – Background

Akzo Nobel started the development of bitumen emulsion technology in the late 1970s in cooperation with a Danish equipment manufacturer, "Marius Pedersen A/S". There were agreements in place regarding development, manufacturing and sales of emulsion equipment.

Akzo Nobel had a separate emulsion plant department responsible for development and sales and marketing of emulsion plants globally. In parallel Akzo Nobel developed, marketed and sold various chemicals for this application. At this time the targeted application was road emulsions.

During the 1990s Marius Pedersen A/S decided to abandon emulsion plant activities. Three employees from Marius Pedersen's started the company Denimotech A/S, taking over the emulsion plant business.

For the last few years, Akzo Nobel has been focusing solely on the chemicals used for road emulsions and do not sell emulsion plants for that application any longer. Today, Akzo Nobel has an "Engineering and Manufacturing Framework Agreement" with Denimotech. This agreement gives Denimotech a license to manufacture and sell emulsion units worldwide for the road asphalt application only. For other applications such as fuel emulsions Denimotech can only manufacture and sell emulsion units to Akzo Nobel. The emulsion unit design consists of Akzo Nobel Proprietary

Equipment.

Since 1980, more than 100 emulsion plants have been sold to various customers worldwide for manufacturing bitumen emulsions for asphalt applications.

4.3 Fuel Emulsions

Over the last 10 years, Akzo Nobel has dedicated significant R&D resources to extend the asphalt emulsion technology to the fuel emulsions application. The foundation for this venture is Akzo Nobel's unique combination of a broad product portfolio and more than 30 years in-depth experience in manufacturing and developing various bitumen emulsions. Also, in most other surface chemistry applications, emulsification is the core technology providing important know-how and experience for the emulsified fuels application. Altogether this has now resulted in a proven new technology. A wide range of feedstocks (natural bitumen and various refinery residues) and emulsifiers have been used during formulation work to meet various fuel specifications.

4.4 Patents

Akzo Nobel holds two patents related to the emulsified fuel technology.

<i>Patent No.</i>	<i>Assignee</i>	<i>Priority Date</i>	<i>Publication</i>	<i>Description</i>
US 6113659	Akzo Nobel NV	2/3/99	9/5/00	Process claims for making an emulsion from a high melting point hydrocarbon feedstock
US 6194472	Akzo Nobel NV	4/2/98	2/27/01	Continuous process to make colloidal dispersions of high melting hydrocarbons in water e.g. ROSE residuums

In addition to these, a number of "Invention Disclosures" are currently being evaluated. Akzo Nobel anticipates filing several patent applications based on these inventions shortly.

4.5 Experience – Proof of the Technology

Further to the in-depth experience of manufacturing bitumen emulsions for asphalt applications, the following demonstrations have been accomplished for power generation applications.

Dec 2002	Innogy AkzoNobel	20 tons of bitumen emulsified and combusted
April 2003	ENEL Livorno, Italy	20 tons of Heavy Fuel Oil emulsified and combusted
June 2003	Innogy Fawley, UK	50 tons of bitumen emulsified and combusted
March 2004	ENEL Sulcis, Italy	2800 tons emulsified, stored for 3 months and combusted
Nov 2003 To Feb 2004	Canmet	8 different samples were emulsified and combusted
May 2005	Karlshamm Power (EON) Sweden	500 tons of heavy fuel oil emulsified and combusted
August 2007	Alstom Power ISBF Connecticut, USA	250 tons of bitumen and asphalt emulsified and combusted
May to Sep 2008	Mazeikiu Nafta/ Lietuvos Elektrine, Lithuania	23,000 tons of emulsion fuel manufactured from Visbreaker Residue on the refinery site. More than 1000 hours of emulsion manufacture and Continuous 24/7 operation. Storage for 3 months. The emulsified fuel (MSAR) was successfully transported over 300 kms by railcars and combusted at the Lietuvos Elektrine power station in Lithuania.

In addition to these power generation examples above, demonstrations have been accomplished in Canada in applications related to the steam assisted production of heavy oils such as Steam Assisted Gravity Drainage (SAGD) technology.

A question was posed to QFI from EBRD as to why the MSAR tests carried out prior to Lithuania had not led to adoption of the technology, to which their response was:

“The majority of MSAR tests carried out in the table referenced were undertaken by the original Quadrise founders at a time when Orimulsion was still readily available (pre -2004) and at facilities without air pollution control equipment to operate on a base-load basis – at the time that team felt it important to prove the combustion properties of MSAR and their intention was to install an HFO splitter to manufacture the fuel and market the diluents extracted. Since QFI listed in 2006 and the new management team formed (4Q ‘06) we have redefined our strategy to align a Refiner (with oil splitting facilities pre-installed!) with a suitably equipped Power Company. Aside from Karlshamn, none of the other sites listed would meet our revised screening criteria.”

4.6 Design of Full Scale Projects

As licensor of the proprietary technology, Akzo Nobel would supply the proprietary equipment – the MSAR Manufacturing Unit (MMU). Depending on the nature of each individual installation (i.e. the extent of use of existing equipment, buildings etc) the scope of Akzo Nobel’s supply would vary from project to project. On this

particular project for Lithuania, Akzo Nobel will work closely with Quadris Fuels International (QFI) on the design of the complete installation. QFI will have access to Akzo Nobel expertise throughout the design of the full-scale plant and thus will benefit from Akzo Nobel's long-term experience of emulsion plant development and operation, as well as from their emulsification technology in general.

4.7 Technical Appraisal of the Licensed Technology

- Central to this licensed technology is the variable-speed motor driven Colloid Mill, which produces the desired emulsified product from incoming feed streams, mostly heavy oil and water. The licensor has accumulated a wealth of experience in applications utilising Colloid Mills to produce emulsions. Over 100 plants have been sold worldwide to manufacture bitumen emulsions for road asphalt applications alone. For this MSAR fuel emulsion application, different heavy oil/chemical formulations would be used, but that is not assessed as being unduly different or unproven technology.
- The skid mounted package plant or module, provided under license from the licensor, is available in three different capacity sizes. Thus there is not a scale up problem, as multiple standard modules would be used to achieve the ultimate overall design capacity required.
- The Licensor's past experience of bitumen emulsion plants ensures that high quality metals, such as stainless steels, are used for construction to minimise any corrosion risks, which could be caused by streams such as the chemical solutions in water.
- Emulsion stability is a key element of this application and the licensor has devoted much research and resource to determining suitable product formulations to achieve the required degree of emulsion stability.
- The extremely cold winter temperatures (minus 25 deg C) at the site in Lithuania will require proper winterisation techniques throughout the whole emulsion fuel production plant. This is also a key requirement for the skid mounted licensed package or module licensed by Akzo Nobel, who will provide their advice and experience to the design and construction teams based on similar installations in the Baltic and FSU states.

In summary, it is assessed that there is no unacceptable technical risk from using the Akzo Nobel licensed technology for this MSAR manufacturing plant project in Lithuania.

5 The Commercial Demonstration of MSAR Production

5.1 Background

To demonstrate the operational viability and robustness of MSAR manufacture, transportation and combustion, a Commercial Demonstration was carried out. This demonstration involved the manufacture of some 23,000 tonnes of MSAR (using some 16,000 tonnes of Visbreaker Residue) at the Mazeikiu Nafta refinery during June - September 2008, and for the transfer of some 20,000 tonnes of MSAR for consumption at the Lietuvos Elektrine power station (with an initial 1 day test firing in July) during September 2008, when this power station was required to run on base load during a scheduled routine outage for maintenance of the base load power station at Ignalina. The demonstration utilised existing black oil handling facilities at the refinery and the power station, and used the national Lithuanian railway system to transfer MSAR fuel from the refinery to the power station.

This was the first commercial installation of MSAR production technology in an operating refinery. Major objectives of the demonstration were to confirm (a) the economic benefits to the refinery in terms of reduced consumption of high value cutter stock, and (b) satisfactory and efficient combustion at the power station, meeting EU emissions standards, and (c) that MSAR could compete on economic terms with the use of natural gas or conventional heavy fuel oil at the power station.

5.2 Preparation for Commercial Demonstration

The trial quantity of MSAR fuel was determined by Lietuvos Elektrine as the optimum quantity for them to carry out a full technical assessment of the impact to their boilers and to satisfy the Lithuanian Government Ministries of Economy and Environment.

The technology licensor had previously carried out tests to finalise the emulsion formulations, based on processing the selected heavy oil refinery product (Visbreaker Residue). Pumping and stability tests were carried out by the licensor to confirm formulations and the suitability of the existing heavy oil handling systems at the refinery.

The Mazeikiu Nafta refinery carried out the detailed engineering of plant modifications and tie-ins which were required to facilitate MSAR manufacture. The Lietuvos Elektrine power station used existing liquid fuel handling facilities, which had been suitable for Orimulsion handling when the power station was firing that emulsion fuel. Systems, procedures and equipment were put in place to monitor MSAR quality during manufacture, storage, loading, rail-transfer, and combustion.

QFI were responsible for MSAR inventory at the refinery. The Lietuvos Elektrine power station was responsible for MSAR inventory following custody transfer and storage at the power station. The MSAR product was formulated for a 3-month shelf life from loading onto rail cars at the refinery.

A suitable framework of contractual agreements was put in place to cover the Commercial Demonstration. Main contracting entities were the Mazeikiu Nafta refinery, QFI and the Lietuvos Elektrine power station. The refinery was responsible (a) for refinery operation, and (b) for the supply of the heavy fuel oil feedstock, and (c) for the supply of various services such as utilities, laboratory analyses, logistics,

and other support facilities.

QFI provided project lead personnel and operation of the MSAR Manufacturing Plant (in co-operation with the licensor – Akzo Nobel), and arranged for the necessary contractual agreements covering (a) the purchase of feedstock and other services from the refinery, and (b) the sale of MSAR fuel to the power station, and (c) the MSAR licensing agreements with the technology licensor (Akzo Nobel). The Lietuvos Elektrine power station was responsible for operation of the power station and for purchase of the MSAR fuel from QFI.

5.3 Commercial Demonstration (CD) Reports

A number of reports concerning the commercial demonstration have been seen by the author. Brief summary advice was received during September 2008 from the technology licensor (Akzo Nobel) and from the Mazeikiu Nafta Refinery website. The comprehensive CD report issued by QFI at the end of September 2008 is reviewed in Section 5.4 below.

The author received the following summary advice by e-mail from Akzo Nobel on 19th September: -

Akzo Nobel are scheduling review sessions to summarize the experiences and learning during the coming months when we are able to gather our team again. However, the overall conclusion is that we did not experience any surprises during the demonstration manufacturing, neither from chemistry nor equipment point of view. The manufacturing demonstration at Mazeikiu Nafta has been completed in line with expectations.

On 23rd September, the Mazeikiu Nafta Refinery website (www.nafta.lt/en) posted the following news item in English language: -

Results of emulsified fuel trial test are excellent.

The company Lietuvos Elektrine successfully completed the trial test of emulsified fuel, the new product of Mazeikiu Nafta.

This emulsified fuel was created by Mazeikiu Nafta jointly with the specialists of the British Company, Quadrise Fuels International. Last week burning of the shipment of 20 thousand tons of emulsified fuel was finished.

The main components of the emulsified fuel are water and residual product which the latter results from one of the refining processes (visbreaking). In the blending process emulsifiers are used. The emulsion produced this way may be used as fuel oil. Its viscosity and other quality characteristics are similar to those of the Orimulsion fuel used by Lietuvos Elektrine which was shipped from Venezuela

Excellent results of trial test of Lietuvos Elektrine prove that Mazeikiu Nafta has produced adequate product and Lietuvos Elektrine is ready to use it for energy production.

Based on preliminary estimate Mazeikiu Nafta could produce about 350 thousand tons of emulsified fuel per year for Lietuvos Elektrine demands. At present the specialists

of Lietuvos Elektrine and Mazeikiu Nafta are discussing issues related to the further cooperation.

5.4 Review of QFI's Detailed CD Report

Technical aspects of note in QFI's detailed CD report are as follows: -

Executive Summary

QFI's report concluded that the MSAR commercial demonstration was a success for all the parties concerned and that the quality specifications of MSAR fuel delivered to Lietuvos Elektrine were similar to or superior to Orimulsion. During the period the refinery processed a blend of up to 50% Volve crude, along with the normal slate of Urals crudes, with no significant influence on the quality of the resulting MSAR fuel produced.

The main objectives from the commercial demonstration were fully achieved. A temporary MSAR production system was integrated within the refinery environment to produce commercial quantities of stable emulsion fuel. The MSAR production system could be operated continuously on a 24/7 basis. MSAR fuel could be produced and exported from the refinery alongside conventional heavy fuel oil product (Mazut) using existing dispatch infrastructure. MSAR fuel performance was deemed by Lietuvos Elektrine to be similar to, or in many cases better than, the Orimulsion fuel from Venezuela.

As commissioning of the proposed full capacity MSAR commercial facility is targeted to commence in 4th Quarter 2009, QFI's report recommends that the respective parties should proceed with discussions and conclude framework agreements for future MSAR production at the earliest opportunity.

Commercial Demonstration Production System Design

MSAR was manufactured from Visbreaker Residue, river water and various emulsion chemicals in a temporary 20 tonne/hour MSAR Manufacturing Unit (MMU).

The temporary MSAR production facilities were installed so as to minimise changes to the refinery and to maximise use of existing equipment, piping, infrastructure and operating procedures (Please refer to Appendices, Figures 1 and 2). New and existing equipment and piping were assessed against the recommended operating and handling guidelines for MSAR emulsions. This was so as not to compromise the stability of MSAR emulsions, which can be compromised by excessive temperatures or shear stresses, or contamination with other refinery streams.

The main additional equipment used for the temporary MSAR production facility were the 20 tonne/hour MMU and the necessary buffer storage vessels for feeds and products. A variable speed motor driven MSAR product gear pump was installed to transfer the product to an existing refinery storage tank. Flexible hoses were used for all piping connections within the temporary production facility and for connections to the existing refinery pipelines.

MSAR emulsion fuel was manufactured from the refinery's Visbreaker Residue stream, which was received into the residue buffer storage vessel and then sent into the

MMU. Any hydrocarbon vapour and hydrogen sulphide vapour flashed off inside the residue buffer storage vessel were directed by pipeline to a nearby refinery furnace for incineration. (N.B. Hydrogen sulphide is an extremely hazardous gas to personnel and meticulous safety procedures have to be put in place.)

An existing vessel was used for buffer storage for river water used for emulsion manufacture. The river water proved to be contaminated with sediment, plant matter and other contamination material, and strainers were installed to prevent such contamination reaching the MMU. This aspect would need careful design for a full capacity MSAR production facility.

During the commercial demonstration MSAR was stored in an existing refinery black oil storage tank, which had been prepared by removal, as far as possible, of other black oil products to minimise contamination of the MSAR product. MSAR export from storage was by rail using the refinery's existing black oil rail loading system.

MSAR Production System Operations & Quality Assurance

Production Programme

The overall schedule for commissioning and production of MSAR is shown in Appendices, Figure 3. Once the initial commissioning tests were completed, including the pumping tests, production of MSAR began on a continuous basis.

Production of the MSAR CD fuel quantity (nominally 20,000 tonnes) began on the 28th June and was completed on 2nd September. There were a number of initial problems experienced with the quality of the first volumes of Visbreaker residue received. There were higher than expected contamination with light flushing oil and with a few percent of water. In addition residue and process water temperatures throughout the production period tended to be higher than expected. But the MSAR production process conditions and formulation were adjusted to ensure that the emulsion fuel was within the required specification.

A 10 day outage period was scheduled in advance, commencing 20th July to allow the power-plant to carry out initial fuel and combustion system commissioning tests prior to receiving the remaining CD fuel volumes.

The quality of the process water (direct river water) at times had excessive contamination (e.g. suspended solids) so that frequent filter cleaning was needed and additional sets of filters had to be installed.

Initial Commissioning

Process commissioning of the MMU using Visbreaker residue was completed on the 25th June. Good correlation with the results obtained at the Akzo Nobel laboratories in Sweden was obtained. The target specification for production was determined so that slight adjustments could be made throughout manufacture to maintain optimum MSAR properties

Pump stability testing was carried out during June 26th to 27th. The MSAR showed very high stability with very little or no change in emulsion characteristics.

MSAR Production.

The viscosity of the supplied Visbreaker residue varied somewhat during the production period. It was observed that the viscosity of this residue had a direct effect on the MSAR production viscosity. It was found necessary to make slight adjustments to the chemical addition level &/or the overall level of water to compensate for changes in the emulsion fuel's viscosity. Apart from these adjustments for viscosity control all the other quality parameters remained within expectations and specification, demonstrating the reliability of the process.

During the first period of July, the refinery processed a blend of up to 50% Volve crude along with the normal slate of Urals crudes. This change in the source and quality of crude fed to the refinery would be reflected in the quality of the Visbreaker residue fed to the MMU. But from the QC/QA monitoring programme, it was determined that the change in crude had no significant influence on the resulting MSAR emulsion fuel quality.

MSAR Storage

The initial quantities of water and heavy oils remaining in the final MSAR storage tank, before MSAR production began, caused some initial contamination of MSAR, but this should not be a problem if storage tanks are in the future dedicated for MSAR storage.

MSAR Loading and Deliveries

Trains of 50 wagons each were loaded in 2 rows of 25 x 58-63 tonnes (nominal) wagons at a time. Some 8 trains were loaded and some 20,000 tonnes of MSAR were exported from the refinery. The refinery's standard rail loading procedures were modified to minimise product contamination and physical damage to the emulsion.

The average quantity of fuel for a full block train of 50 rail cars for the CD was 2740 tonnes. MSAR block trains were taken from the refinery, via the Vievis rail terminal, to the Lietuvos Elektrine power station to be docked at the power station's loading facilities.

Health, Safety and Environment (HSE)

A safety manual was prepared in conjunction with the refinery to define the HSE modus operandi. CD operatives were issued with a safety manual and training on the specific health and safety aspects of the operation, in addition to the refinery's safety induction procedures. At all times within the refinery the local refinery requirements were observed and adhered to.

Designated safety clothing was worn within the CD laboratory and within the CD process area. Special precautions and/or working permits were required during certain activities. First aid kits and safety showers were supplied. Material Safety Data Sheets were supplied for the CD chemicals and products being used.

Observations and Recommendations

A list of lessons learned by the parties during the CD at the refinery was summarised

to be as follows: -

- Intermittent issues were experienced with the residue feedstock supply. On occasions the residue was contaminated with higher than expected volumes of flushing oil (a lighter hydrocarbon product) and water, and the residue supply temperature was unexpectedly high, but this is not likely to be a problem after the addition of a Visbreaker vacuum flash system in the future.
- The river water supplied (from surrounding reservoirs) occasionally contained higher than expected levels of solids contamination leading to the need to install strainer filters to the system. Looking forward, a more sophisticated water filtration system should be installed.
- Hydrogen sulphide emissions from contained areas occasionally triggered personnel monitors installed on employees, set to alarm at recommended exposure limits for this gas. Measures can be taken to improve this and to minimise gas escape. This HSE issue will be reduced to an extent after the Visbreaker vacuum flash system is installed in the future.
- Better and more expedient contact arrangements were necessary with refinery departments and personnel relating to day-to-day MSAR operations.
- Two off specification MSAR issues were experienced during fuel loading. Both occasions were handled expediently, but looking forward, if both refinery heavy fuel oil product and MSAR are to be loaded batch wise and using the same rail car loading systems, then a more detailed joint review of loading procedures is recommended to review and mitigate such fuel quality issues.
- Finally, it was noted that this CD was undertaken during summertime ambient conditions, which were more amenable to operations. In addition, for this CD, the residue feedstock was Visbreaker residue, whereas in future vacuum flashed Visbreaker residue material is expected to be the feedstock, which would need adjustments to emulsion formulations and MMU operating conditions.

5.5 Technical Appraisal of the Commercial Demonstration of MSAR Production

As noted above, there were a number of lessons learned by the parties concerned after this commercial demonstration of MSAR production at the Mazeikiu Nafta Refinery. However the technology licensor (Akzo Nobel), the Sponsor (QFI), the Mazeikiu Nafta Refinery and the Lietuvos Elektrine power station were all satisfied that it was a successful demonstration of MSAR production.

In summary, no unacceptable technical risk has been identified from this review of advice and reports available concerning the Commercial Demonstration of MSAR production at the Mazeikiu Nafta Refinery in Lithuania.

6 The Mazeikiu Nafta Refinery in Lithuania

The following is based mainly on information about the refinery obtained by desk research from the internet (such as the refinery website - in English language - at <http://www.nafta.lt/en>). The author has no reason to doubt the accuracy of the information given below, although some of the website-derived information may not be absolutely up to date with regard to the current refinery situation.

During the author's visit to the refinery on 27th August 2008, a brief meeting was held with Mr Albertas Gimbutas, Deputy General Director for Production, who confirmed a number of information items (as given below) about the refinery's current operations and future plans.

6.1 Brief History of the Refinery

The Mazeikiu Nafta Refinery is situated in the northwest of Lithuania, quite near the border between Lithuania and Latvia, and about 90 kilometres from the Baltic Sea coast and the coastal oil terminals at Butinge, Klaipeda and Ventspils.

The refinery was developed in three main stages to process crude oil feedstock, all of which initially was supplied by the Druzhba (or Friendship) pipeline from the former Soviet Union. Commissioning of the first "hydroskimming" stage of the refinery took place in 1980, this first "LK-6U" Unit consisting of atmospheric distillation, catalytic reforming, distillate hydrotreating and a gas plant. Commissioning of the second "hydroskimming" stage followed in 1984 consisting of a second "LK-6U" Unit. In 1989, the third stage (a "conversion" stage, identified as the "KT-1/1" Unit) was commissioned, consisting of heavy oil vacuum distillation, visbreaking, distillate hydrotreating, catalytic cracking and an associated gas plant.

Over the following years, refinery ownership and management was reorganised several times until in 2006 PKN ORLEN, a Polish Company, became the major shareholder of the Mazeikiu Nafta Refinery and remains so today. This refinery is the only oil refinery located within the three Baltic States of Lithuania, Latvia and Estonia.

6.2 Meeting with Refinery Management

The author and QFI representatives met Mr Albertas Gimbutas, Deputy General Director for Production, at the refinery during the plant visit on 27th August 2008. Mr Gimbutas confirmed the following about the refinery's current operations and future plans:

- There are two hydroskimming blocks of process units. Crude capacity of the first block is some 4 to 5 million tonnes per year, and of the second block is some 10 to 11 million tonnes per year. To an extent, the first block represents "spare" crude oil processing capacity. The third block of units is the catalytic cracking or conversion block of units.
- The refinery is looking to add a hydrocracker-based conversion block of units with capacity of about 1.8 million tonnes per year for additional processing flexibility.

- The refinery exports to outside Lithuania a significant proportion of its products and thus is looking to meet relevant EU product specifications.
- The refinery has not experienced any problems with the local supply of fresh water. There is a nearby reservoir which is used to supply fresh water for uses such as boiler feed water and make up to recirculating cooling water systems.
- Different crude feedstocks are blended for processing rather than segregated. Optimisation of such crude oil blending is made using PIMS based software.
- When in future the onsite power station is converted to firing residue, power station consumption is estimated to be 65 tonnes per hour (or 600,000 tonnes of heavy oil per year). Surplus heavy oil could then be utilised to manufacture MSAR for dispatch to the remote power station at Lietuvos Elektrine.
- In the future, electricity prices in Lithuania (as elsewhere) are expected to increase greatly, especially when the nuclear power station at Ignalina in Lithuania is closed down. Thus in the future the refinery anticipates selling excess power to the grid from the onsite power station at profitable price levels.
- Mr Gimbutas agreed to advise us the refinery's Crude and Product slates for recent years. He mentioned that they are assessing five new crudes for possible future processing. Later, we received a summary 2005-2008 Production Report for products, but were not able to obtain detailed crude slates. On the telephone, Mr Gimbutas advised that at least 80% of crude supplies have normally been from Russia via pipeline. After that they consumed North Sea crudes (e.g. Flotta), Norwegian crudes (e.g. Volve), and two Venezuelan crudes. Consumption of each of these crudes amounted to a few hundred thousand tonnes per year.
- The crude oil pipeline from the coastal oil terminal was stated to be of sufficient capacity to provide all of the refinery's needs (10 to 11 million tonnes per year). In this case they would not need to use Russian crude oils via the pipeline from Russia.
- Dispatch of refinery products is almost entirely by rail with much smaller volumes going out by road transport. At present there appears to be no use of product pipelines.

6.3 2005-2008 Production Report

The following refinery production information was provided by Mr Gimbutas:

2005-2008 Production Report

Product	2005	2006*	2007*	2008 (7months)
Gasoline	2700000 t	2300000 t	1700000 t	1600000 t
Kerosine	570000 t	550000 t	150000 t	330000 t
Diesel	3050000 t	2500000 t	1900000 t	1800000 t
Heavy fuel oil	1600000 t	1800000 t	1100000 t	1000000 t
LPG	450000 t	404000 t	290000 t	230000 t
Sulphur	75000 t	62000 t	43000 t	44000 t
Bitumen	170000 t	160000 t	95000 t	77000 t
Crude oil	9300000 t	8400000 t	6000000t	5600000 t

* **Note:** For the years 2006 and 2007, refinery throughput was impacted by a fire in the refinery Vacuum Distillation Unit. Starting in the year 2008, the VDU was returned into operation.

6.4 Refinery Processes

The Mazeikiu Nafta Refinery is basically a fuels refinery which includes a Catalytic Cracking complex. Target products are transportation fuels such as gasolines, kerosines/jet fuels and diesels. During the refining process, they also obtain a number of by-products such as various grades of bitumen, domestic heating oil, and elemental sulphur.

The major processes of the refinery include:

- Atmospheric crude oil distillation
- Catalytic Reforming
- Kerosine hydrotreating
- Diesel hydrotreating
- Vacuum distillation of heavy oils
- Catalytic cracking
- Absorption and gas fractionation
- MTBE production
- Bitumen production
- Sulphur production
- Visbreaking
- Hydrogen production

6.5 Modernisation

Since the year 2000, the refinery has been steadily implementing a series of modernisation programmes (a) to improve product qualities to meet future EU specifications, and (b) to make the refinery operations more flexible and efficient, and (c) to reduce environmental impact. Construction of a Penex Feedstock Preparation Unit and a Penex Isomerisation Unit were completed in 2003, and their offsite product blending and loading systems were upgraded.

After this, several existing process units were revamped and upgraded, and in 2007 a new FCC Gasoline Selective Hydrotreater Unit was commissioned. Also in 2007, construction of a new Hydrogen Plant was started to prepare for increased future hydrogen consumption to meet lower diesel product sulphur specifications.

Major future investment plans are being directed to building a new hydrocracking unit (see below) to increase output of high quality distillates, such as low sulphur diesel. The Catalytic Cracking Complex will be upgraded to increase capacity and to achieve a deeper level of heavy oil refining, thus reducing production of visbreaker residue.

Other modernisation projects are envisaged over the next five years to enable products to meet EU product quality requirements and to meet stricter environmental standards. During the coming five years, the refinery plans to invest over \$1.6 billion US dollars into the overall major modernisation programme. As the modernised refinery is expected to export up to 65% of total production, a crucial element of the modernisation plan would be the construction of a product pipeline for reliable

transportation of products to existing coastal oil terminals on the Baltic Sea (either Klaipeda or Butinge). The refinery is actively promoting a development plan for such a product pipeline from the Mazeikiu Nafta refinery to the coast, but at present it is understood that such an improvement in product export facilities has not yet received the full governmental approvals.

Hydrocracker Upgrading Project

As outlined above, significant new investment is planned for the refinery over the next five years. The most costly new process unit envisaged would be a new hydrocracker. This is a versatile process for upgrading various feedstocks to high-quality light distillate products. This technology can produce LPG, naphthas/gasolines, distillates/jet-fuels and high-quality diesels by conversion of heavier feedstocks and hydrogen addition. The process usually operates at elevated pressures in the presence of a catalyst, which is selective for conversion of the design feedstock to the desired products. Hydrocracking can improve the quality of virtually any refinery product via blending or additional processing.

As operating pressures can be as high as about 150 bars, and hydrogen consumption is significant, hydrocracking is one of the most expensive refinery processes. But there are valuable benefits to the refinery in terms of higher quality products, with for instance lower sulphur contents and other important transportation fuel properties.

The net effect of a hydrocracker based refinery upgrade would be to increase production of more valuable products such as diesels and jet fuels, while reducing production of heavy fuel oils. While this would be beneficial to the refinery as a whole, it would reduce the availability of heavy oil residue feedstock to an MSAR manufacturing plant. The results of one study into this effect show that, after installation of such a new hydrocracker, net refinery exports of high sulphur heavy fuel oil would be reduced to 560,000 tonnes per year in summer or 660,000 tonnes per year in winter. This study also assumed that the onsite 200MW power station would consume 620,000 tonnes per year of heavy fuel oil. Initially much higher quantities of heavy fuel oil feedstock would be available before a new hydrocracker plant was completed. These considerations will have to be taken into account when planning the feedstock availability for a new MSAR emulsion production plant.

6.6 Environment

Regular independent environmental audits are carried out both at the refinery and in nearby areas to ensure compliance with industry standards. During recent years the refinery has significantly improved the quality of treated water and atmospheric emissions.

The refinery has introduced an environmental management system, which is aimed to be certified on the basis of ISO 14001:2004 standard.

6.7 Marine Terminal at Butinge

The Butinge Terminal is situated on the coast of Lithuania in an all-year-round ice-free area of the Baltic Sea. The first crude oil tanker was loaded at Butinge in 1999 with a shipment of YUKOS crude oil. The terminal can export up to 14 million tonnes of crude oil a year. It is both an import and an export crude oil terminal and can

accept import cargoes. A crude oil pipeline connects the Butinge Terminal with the Mazeikiu Nafta Refinery

Onshore Part

The onshore part of the terminal includes crude oil tanks, a pumping station, a boiler house and other auxiliary facilities such as fire fighting, compressor station, control room and laboratory.

Originally crude oil for exporting was sent to the terminal's tanks through a 91.5 kilometre, 13 million tonnes per year pipeline from the Mazeikiu Nafta Refinery. Total capacity of the terminal's five crude oil tanks is 254,000 cubic metres. Now the terminal's facilities are also used to import shipments of crude oil from tankers.

Terminal operations, such as loading and discharging, are controlled from a computerised control room. Laboratory analyses are carried out by a third-party, UK headquartered, International Testing Service (ITS) in accordance with Russian (GOST), European (IP) and US (ASTM) standards.

Offshore Part

The offshore part of the terminal includes an offshore crude oil pipeline and a single point mooring (SPM) buoy where crude oil can be loaded onto or discharged from crude oil tankers. The 9.6 kilometre, 36 inch, offshore pipeline was constructed in 1998 and is equipped with a leak detection system. The terminal can accommodate vessels of up to 150,000 DWT. The terminal has no ship generated waste or cargo residue facilities, so vessels cannot discharge these at the terminal.

Environment

Specialists from Klaipeda University in Lithuania regularly monitor the offshore and onshore environment around the terminal to ensure that the terminal operations have minimum impact on the environment. The terminal's personnel conduct regular oil spill prevention and response exercises, and the terminal is an active member of the Oil Companies International Marine Forum (OCIMF) and Oil Spill Response Organisation.

6.8 Pipeline Systems

The Mazeikiu Nafta Refinery operates a system of pipelines with a total length of about 500 kilometres. At present these are crude oil pipelines to and from the refinery and the Butinge Terminal. As mentioned above, in the future the modernised refinery is expected to export up to 65% of total production, so that a crucial element of the modernisation plan would be the construction of a product pipeline for reliable transportation of products to an existing coastal terminal on the Baltic Sea. The refinery is actively promoting a development plan for such a product pipeline, from the Mazeikiu Nafta refinery to the coast, but at present it is understood that this improvement for product exports has not received the full governmental approvals.

6.9 Observations during Refinery Visit

Satisfactory security and induction systems were in place for visitors to the refinery. The refinery site occupies a very large area of land, providing reasonably safe

distances between the various facilities. On the whole however the refinery does show its age, and the maintenance of several roads around the processing area was not good.

Most products are transported from the refinery by rail and we observed the black oils loading rack which was being used to load MSAR fuel onto rail wagons. Some 50 wagons would be loaded at a time with care being taken not to mix MSAR fuel with refinery heavy fuel oil (“Mazut”) product. Over 2,500 tonnes of MSAR could be loaded onto one 50 wagon “block train”. This loading operation could be completed in about one hour, as all the 50 rail wagons would be loaded in parallel. Some 8 trainloads of MSAR were being sent to the Lietuvos Elektrine power station to enable them to conduct the demonstration combustion trials.

It was noted that the refinery had 4 elevated flares for combustion of emergency releases of combustible gases in case of upset operations in the refinery. During the visit very little gas was being burnt at the flares indicating that very little excess fuel gas was being flared. This situation normally indicates good housekeeping and operation of the refinery fuel gas systems, and that combustible gases being produced within refinery processes are being efficiently utilised as fuel for the refinery’s furnaces, or recycled within process units.

However, it was noticed that the gases emitted from one of the refinery sulphur plant stacks was slightly blue in colour, which indicated excessive emissions of sulphur oxides from that stack, which would be having a resulting negative effect on the local atmospheric environment.

6.10 Technical Appraisal of the Mazeikiu Nafta Refinery

- This large capacity oil refinery was originally put into operation in 1980, and has undergone many additions and upgrading projects since. Originally crude oil supply was entirely by pipeline from the former Soviet Union (now from Russia), but the refinery is well aware of the risk of interruptions in this supply from Russia, and is studying how to diversify crude oil supplies by importing overseas crude oils via the oil terminals on the coast such as at Butinge, and then via the existing pipeline to the refinery. Quality of imported crude oils would have to be suitable for the refinery configuration of process units, but this should not be a problem as the refinery has the use of sophisticated crude oil planning software (PIMS) which is used by many refineries worldwide.
- The refinery has been under new ownership since 2006 and the new ownership is contemplating major modernisation investment over the next five years. Addition of a new hydrocracker will reduce the quantity of heavy oil feedstock available for MSAR production, but a new hydrocracker complex will take quite a few years to complete, giving a window of probably some five years of higher initial MSAR production levels as described above in Sections 2.0 and Section 6.5.
- At present most products are dispatched by rail with relatively small amounts by road tanker. Plans are under way to construct a product pipeline from the refinery to the coastal oil terminals and this would greatly improve product movements from the refinery.

- Currently the marine terminal at Butinge appears to be only capable of crude oil imports, exports and storage. If a product pipeline were built from the refinery to Butinge, this terminal would need to be made capable of also handling and storing the products to be exported. Both the onshore and offshore facilities at the terminal would have to be made capable of handling products as well as crude oils. This could be a significant investment requirement. An alternative also being explored is a longer pipeline to the port of Klaipeda that does have facilities for product exports. In the meantime, product movement from the refinery will continue to be by rail wagons (mainly) and road tankers.
- Environmental matters are addressed in a reasonable manner by the refinery staff and there is in place an Environmental Management System, which they aim to have certified to international standards.

In summary, it is assessed that there is no unacceptable technical risk in locating the MSAR Manufacturing Plant at the Mazeikiu Nafta Refinery in Lithuania.

7.0 Summary of Possible Technical Risks

7.1 Introduction

The overall purpose of the Phase 1 technical due diligence for EBRD is to discover any actual or potential problems with the use of MSAR technology for this project. The second phase of technical due diligence (Phase 2) will be contingent upon EBRD deciding to proceed with Phase 2 due diligence after considering the results of the Phase 1 study.

This section of the report provides a summary of this Preliminary Appraisal including an assessment of whether the technology is proven and if there are any potential technology risks involved.

7.2 The Project

There will be the opportunity to manufacture MSAR fuel on a full-scale capacity basis at the Mazeikiu Nafta refinery in Lithuania, and to supply this fuel to the Lietuvos Elektrine power station (also in Lithuania) starting approximately in the 4th Quarter of year 2009. The MSAR fuel produced at the refinery would be transported by rail to the Lietuvos Elektrine power station via the national railway system, which is operated and controlled by the Lithuanian Railways, over a distance of approximately 300 kms

The design capacity of the full scale MSAR Manufacturing Plant (MMP) to be actually installed at the refinery would depend on several factors. Most importantly would be the amount of heavy residue feedstock that the refinery could commit to supplying to the MMP.

It is expected that the refinery will continue to process similar quality crude oils to the current crude diet, which is predominantly Russian crude oils from the Urals region. These are similar to the original design, and are the majority of the current crude oil feeds and the refinery configuration will be suited to such feedstocks. However other crude oils have been and are being assessed by the refinery due to the risk of supply interruptions from Russia.

Additionally, the refinery is in the process of implementing a major upgrading and modernisation programme which when completed will have the effect of increasing production of distillate products (such as gasoline and diesel) and reducing production of heavy residue streams, such as heavy fuel oil. The refinery's own on-site power station will also start to consume residue-based fuel from around 2011 onwards.

Such factors indicate that, in the initial years of operation, larger quantities of heavy residue feedstock could be available as feedstock for MSAR production than in the later years, after the refinery has been upgraded. It may be possible however to source additional volumes of refinery residue from other refineries in the region.

QFI (the Sponsor) have concluded, as an initial basis, that the MMP should consist of up to five 40 metric tonnes per hour (of MSAR production capacity) manufacturing modules, giving a total of up to 200 metric tonnes per hour maximum MSAR production capacity, which would ensure adequate an overcapacity margin to cover potential production outages due to unforeseen operational problems.

7.3 The Sponsor

QFI (The Sponsor) has an agreement with Akzo Nobel (The Licensor) covering the use of Akzo Nobel's licensed technology for this MSAR Manufacturing Plant in Lithuania.

The capability of QFI comes from this agreement with Akzo Nobel and from the in-depth relevant expertise of QFI's personnel, particularly their experience in the Orimulsion business, another oil in water emulsion fuel that in the recent past was fired in commercial power boilers.

Key QFI personnel have previously held senior positions in major oil companies such as British Petroleum and Shell, and in engineering and project management companies such as Foster Wheeler. Their experience with these companies would enable them to manage the implementation of this Lithuanian project, which would be relatively small in investment cost terms compared with other high capital cost projects with which they have had experience.

Although a small company in terms of the number of its personnel, QFI operates on an outsourced business model managed by core technical specialists. It might however be necessary for QFI to either expand its permanent staff numbers, or to employ a project management company to oversee and monitor in detail the work of engineering and construction contractors to be engaged on this project.

In summary, it is assessed that there is no unacceptable technical risk from QFI undertaking the sponsorship and to complete this MSAR manufacturing plant project in Lithuania.

7.4 The Licensor and the Licensed Technology

Central to this licensed technology is the variable speed motor driven Colloid Mill, which produces the desired emulsified product from various incoming feed streams, mostly heavy oil and water. The licensor has accumulated a wealth of experience in applications utilising Colloid Mills to produce emulsions. Over 100 plants have been sold worldwide to manufacture bitumen emulsions for road asphalt applications alone. For this MSAR fuel emulsion application, different heavy oil/chemical formulations would be used depending on the quality of the heavy oil feedstock but that is not assessed as being unduly different or unproven technology. The technology is well capable of handling heavy oil feedstocks over a wide quality range.

The skid mounted package plant or module, provided under license from the licensor, is available in three different standard capacity sizes. Thus there is not a scale up problem, as multiple standard modules would be used in parallel operation to achieve the overall throughput capacity required.

The Licensor's past experience of bitumen emulsion plants ensures that high quality metals, such as stainless steels, are used for construction to avoid corrosion risks which could be caused by process streams such as chemical solutions in water.

Emulsion stability is a key element of this application and the licensor has devoted much research and resource to determining suitable product formulations to achieve the required degree of emulsion stability.

The extremely cold winter ambient temperatures at the site in Lithuania will require appropriate winterisation techniques throughout the whole emulsion production plant. This is also a key requirement for the skid mounted licensed package or module licensed by Akzo Nobel, who would have to provide their advice and experience to the design and construction teams from similar installations in the Baltic and FSU states.

In summary, it is assessed that there is no unacceptable technical risk from using the Akzo Nobel licensed technology for this MSAR manufacturing plant project in Lithuania.

7.5 The Commercial Demonstration of MSAR Production

To demonstrate the operational viability and robustness of MSAR manufacture, transportation and combustion, a Commercial Demonstration was carried out. This demonstration involved the manufacture of some 23,000 tonnes of MSAR (using some 16,000 tonnes of Visbreaker Residue) at the Mazeikiu Nafta refinery during June - September 2008, and for the transfer of some 20,000 tonnes of MSAR for consumption at the Lietuvos Elektrine power station (with an initial 1 day test firing in July) during September 2008, when this power station was required to run on base load during a scheduled routine outage for maintenance of the base load power station at Ignalina. The demonstration utilised existing black oil handling facilities at the refinery and the power station, and used the national Lithuanian railway system to transfer MSAR fuel from the refinery to the power station.

A number of reports concerning the commercial demonstration have been seen by the author. Brief summary advice was received during September 2008 from the technology licensor (Akzo Nobel) and from the Mazeikiu Nafta Refinery website. The comprehensive CD report prepared by QFI at the end of September 2008 is reviewed in Section 5.4 of this report.

QFI's report concluded that the MSAR commercial demonstration was a success for all the parties concerned and that the specifications of MSAR fuel delivered to Lietuvos Elektrine were similar to or superior to Orimulsion. During the period the refinery processed a blend of up to 50% Volve crude along with the normal slate of Urals crudes with no significant influence on the quality of the resulting MSAR fuel produced.

QFI's main objectives from the commercial demonstration were reported to be fully achieved. A temporary MSAR production system was integrated within the refinery environment to produce commercial quantities of stable emulsion fuel. The MSAR production system could be operated continuously on a 24/7 basis. MSAR fuel could be produced and exported from the refinery alongside conventional heavy fuel oil product (Mazut) using existing dispatch infrastructure. MSAR fuel performance was deemed by Lietuvos Elektrine to be similar to, or in many cases better than, the Orimulsion fuel from Venezuela.

If commissioning of the proposed full capacity commercial facility is to commence in 4th Quarter 2009, QFI's report recommends that the respective parties should proceed with discussions and conclude framework agreements for future MSAR production at the earliest opportunity.

There were a number of lessons learned by the parties concerned after this commercial demonstration of MSAR production at the Mazeikiu Nafta Refinery. However the technology licensor (Akzo Nobel), the Sponsor (QFI), the Mazeikiu Nafta Refinery and the Lietuvos Elektrine power station were all satisfied that it was a successful demonstration of MSAR production.

In summary, no unacceptable technical risk has been identified from this review of advice and reports available for the Commercial Demonstration of MSAR production at the Mazeikiu Nafta Refinery in Lithuania.

7.6 The Mazeikiu Nafta Refinery in Lithuania

This large capacity oil refinery was originally put into operation in 1980, and has undergone many additions and upgrading projects since. Originally crude oil supply was entirely by pipeline from the former Soviet Union (now from Russia). But the refinery is well aware of the risk of interruptions in this supply from Russia, and is diversifying its crude oil supplies by importing overseas crude oils via the oil terminals on the coast such as at Butinge, and then via the existing crude oil pipeline to the refinery. Qualities of imported crude oils have to be suitable for the refinery configuration of process units, but this is not causing any problem as the refinery has the use of sophisticated crude oil planning software (PIMS) which is used by many refineries worldwide.

The refinery has been under new ownership since 2006 and the new ownership is contemplating major modernisation investment over the next five years. Addition of a new hydrocracker will reduce the quantity of heavy oil feedstock available for MSAR production, but completion of a new hydrocracker complex will probably take some five years to complete, giving this time window for higher initial MSAR production levels as described above in Section 2.0 and Section 6.5.

Currently the marine terminal at Butinge appears to be only capable of crude oil imports, exports and storage. If a product pipeline were built from the refinery to Butinge, this terminal would need to be made capable of also handling and storing the products to be exported. Both the onshore and offshore facilities at the terminal would have to be made capable of handling products as well as crude oils. This could be a significant investment requirement. In the meantime, product movement from the refinery will continue as at present by rail wagons (mainly) and road tankers.

Environmental matters are addressed in a reasonably up to date manner by the refinery staff and there is in place an Environmental Management System, which they aim to have certified to international standards.

In summary, it is assessed that there is no unacceptable technical risk in locating the MSAR Manufacturing Plant at the Mazeikiu Nafta Refinery in Lithuania.

7.7 Conclusion

It is concluded that the MSAR production technology is essentially proven, and that any further technology developments would only be to make emulsion formulation adjustments to allow for heavy oil feedstock quality variations and that the technology licensor (Akzo Nobel) is fully capable of determining such formulation adjustments.

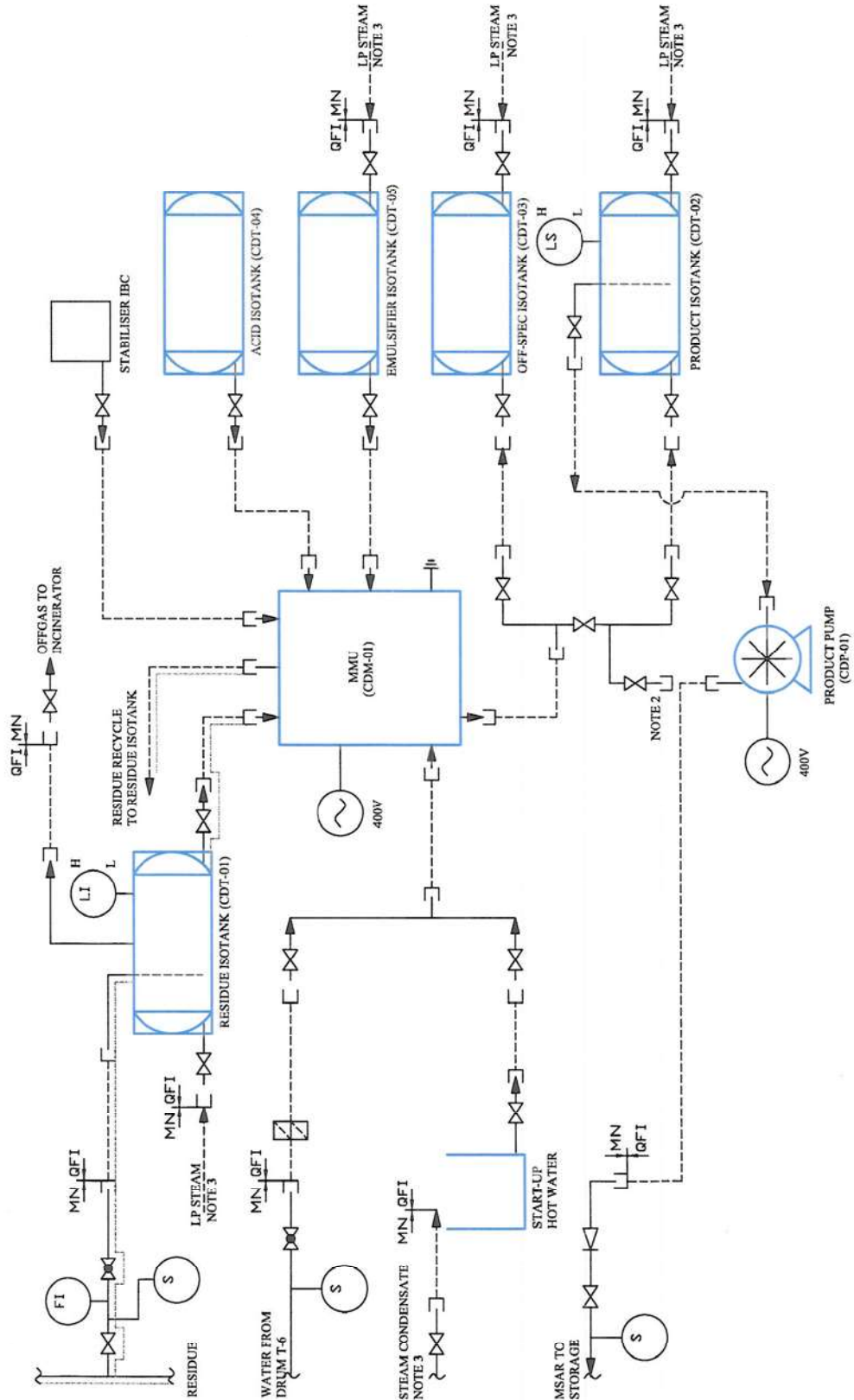
Appendices – Figures

Figure 1 – MSAR CD Process Flow Diagram

Figure 2 – MSAR CD Plot Plan

Figure 3 – MSAR CD Production Schedule (Actual)

Figure 1 - MSAR CD Process Flow Diagram



NOTES:-

1. MMU LOCATED IN A NON CLASSIFIED AREA.
2. DURING COMMISSIONING/PRODUCT TESTING THE PRODUCT PUMP DISCHARGE FLEXIBLE HOSE IS CONNECTED TO THE SPARE CONNECTION TO ALLOW CIRCULATION AROUND THE PRODUCT ISOTANK.
3. INTERMITTENT USE.

MSAR@ COMMERCIAL
DEMONSTRATION



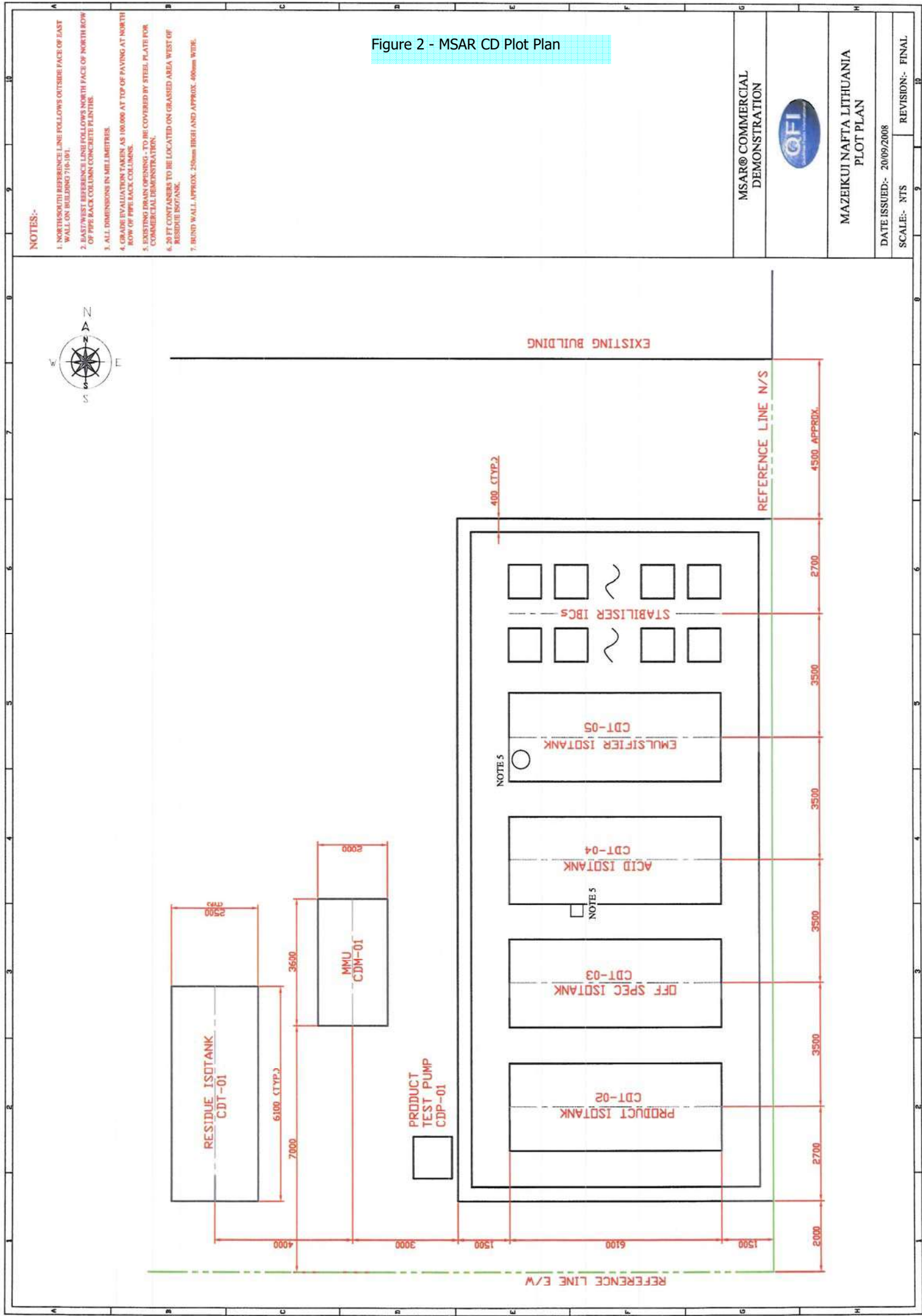
MAZEIKUI NAFTA LITHUANIA
FLOW SCHEME

DATE ISSUED:- 20/09/2008

SCALE:- NTS

REVISION:- FINAL

Figure 2 - MSAR CD Plot Plan



MSAR® Production & QA Data

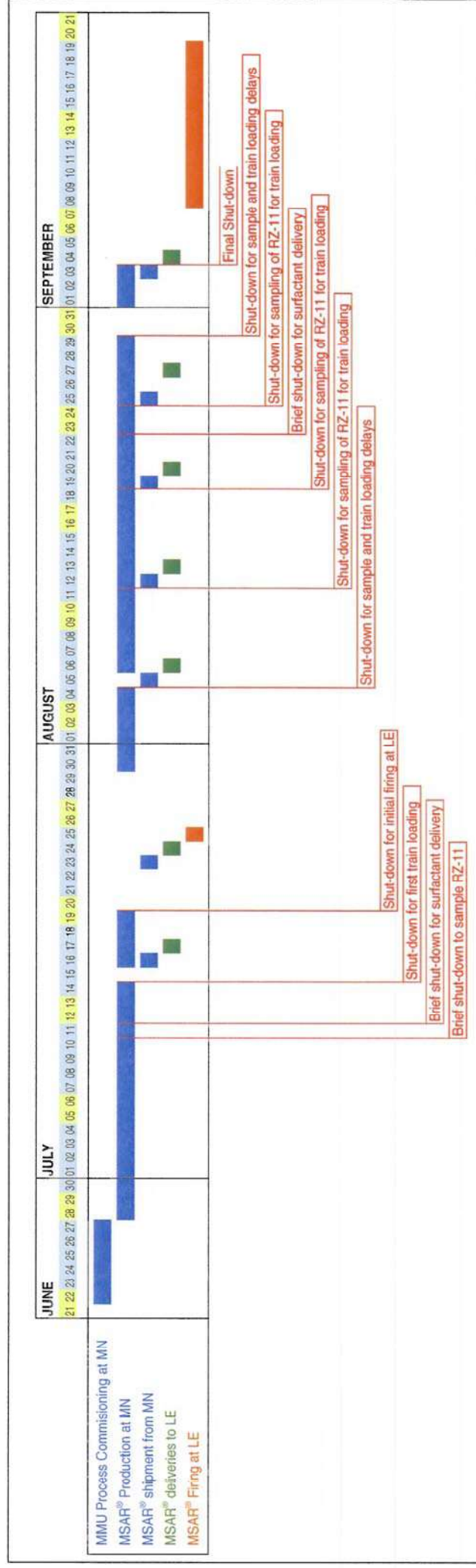


Figure 3 –MSAR® Commercial Demonstration – Actual Production Schedule