REPORT/RAPPORT : SF/2013/36

Smart Fish
Secure fisheries Secure futures

Programme for the implementation of a Regional Fisheries Strategy for the Eastern and Southern Africa and Indian Ocean Region

Programme pour la mise en oeuvre d'une stratégie de pêche pour la région Afrique orientale-australe et Océan Indien

POTENTIAL FOR ENERGY SAVING MEASURES IN THE TUNA INDUSTRY IN THE SOUTHERN EASTERN INDIAN OCEAN REGION

2012

Funded by European Union

COMMISSION DE L'OCÉAN INDIEN

Implementation of a Regional Fisheries Stategy For
The Eastern-Southern Africa
And Indian Ocean Region

10th European Development Fund
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Implementation of a Regional Fisheries Strategy
For The Eastern-Southern Africa and India Ocean Region

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This report has been prepared with the technical assistance of
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2012

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ACRONYMS:

Amphr	Ampere hour
ESA-IO	East Southern African Indian Ocean
FDM	Froid des Mascareignes
HFO	Heavy fuel oil
IOTOA	Indian Ocean Tuna Operators Association
kW	Kilowatt
kWh	Kilowatt-hour
kVA	Kilo volt amps
MDM	Mer des Mascareignes
MBP	Marine Biotechnology Products
MVA	Mega volt amps
NEA	National Electricity Authority
TDM	Thon des Mascareignes

1. OVERVIEW OF THIS ASSIGNMENT (LAYMAN'S SUMMARY)

In February 2011 the Implementation of the Regional Fisheries Strategy (IRFS) was launched with the aim of contributing to the social, economic and environmental development in the East Southern African - Indian Ocean region through the sustainable exploitation of the fisheries resources.

This report falls under Result 4 of the programme where work is being done to assist the Indian Ocean Tuna Operators Association (IOTOA) to achieve various sustainable operating goals. This particular project was to look at the environmental aspects of various tuna operations within the IOTOA and provide advice to the members on energy efficiency improvements that could potentially be made to their operations. Seven members of the IOTOA agreed to take part in this exercise.

The energy investigation phase commenced in November 2011 and focused on a number of areas i.e. the assessment of the energy usage at the seven operating plants identified for this project, attempting to benchmark these plants with one another as well as internationally, investigating potential energy reduction measures and/or possible use of alternative energy sources ideally of a sustainable nature.

Each of these factories was visited during the period 7 – 30 November 2011 and discussions were held with the operations and technical personnel at each facility in order to gather information and insights into the various operations.

Potential alternative sources of energy were investigated and, where possible, discussions held with the National Electrical Power Authorities.

This report has been produced as a result of this assignment. A number of areas were identified where energy efficiency improvements can be made, budget estimates have been prepared and a roadmap for a project rollout programme has been suggested.

2. EXECUTIVE SUMMARY

The Implementation of Regional Fisheries Strategy (IRFS) was launched in February 2011 with the aim of contributing to the social, economic and environmental development in the ESA-IO region through the sustainable exploitation of the fisheries resources. The investigation into the energy usage at the seven operating plants who are members of the IOTOA started on 7th November 2011 and ended on 29th November 2011.

The seven operating plants that agreed to take part in this investigation are:

1. Thon des Mascareignes	(Mauritius)
2. Marine Biotechnology Products	(Mauritius)
3. Mer des Mascareignes	(Mauritius)
4. Froid des Mascareignes	(Mauritius)
5. Pêche et Froid Océan Indien	(Madagascar)
6. Mauritius Freeport Development	(Mauritius)
7. Indian Ocean Tuna	(Seychelles)

Information was gathered with respect to all forms of energy consumed at each plant and an understanding gained of the detailed operations of each section of each plant through interviews and discussions with operational personnel.

Benchmarking figures were developed for comparison purposes. Assessments were then made of those areas identified at each plant where potential energy efficiency improvements could be effected either via operational changes or by equipment replacement.

In addition to this, alternative sources of energy were investigated. The feasibility of wind and solar energy were considered as sustainable energy sources possibly suitable for this environment.

Recommendations and estimated costs were prepared. The recommendations are detailed in the separate reports for each individual plant that was investigated, but can be summarized as follows:

- Due to the size of the plants and quantity of electrical power required in each case (1.5 MVA to 3 MVA), both wind and solar energy sources were deemed to be not suitable. This is because of the economics (capital and maintenance costs) and operational practicality (space and technical resources) for units of this size.
- In general the plants were found to be relatively modern with state-of-the-art equipment and well maintained. Opportunities for significant energy reductions are therefore limited. However, in at least five of the plants, a number of practical improvement measures were deemed possible.
- The greatest potential for reducing energy consumption would be to develop a symbiotic relationship with the National Electricity Authority where there are power generation plants in close proximity (say, < 3 km) to the tuna processing factories. These power generating plants could be modified to accommodate boilers (heat exchangers) to produce process steam from the waste heat of the gas turbines and/or engines exhaust gases and transfer this steam to points of demand. This would eliminate the need for the tuna processing plants to produce their own steam. The savings and benefits could be substantial.
- This scenario could be considered within or as part of a national strategy for a wider range of industries.

3. RÉSUMÉ EXÉCUTIF IOTOA – ENERGIES

La mise en place d'une stratégie de pêche régionale (IRFS) a été lancée en février 2011, avec le but de contribuer au développement social, économique et environnemental dans la région ESA-IO, au travers d'une exploitation durable des ressources halieutiques.
Les investigations en termes d'utilisation de l'énergie chez les sept opérateurs membres de l'IOTOA ont commencé le 7 novembre 2011 et se sont terminées le 29 novembre 2011.

Les sept opérateurs qui ont accepté de prendre part à cette étude sont :

1. Thon des Mascareignes	(Maurice)
2. Marine Biotechnology Products	(Maurice)
3. Mer des Mascareignes	(Maurice)
4. Froid des Mascareignes	(Maurice)
5. Pêche et Froid Océan Indien	(Madagascar)
6. Mauritius Freeport Développement	(Maurice)
7. Indian Ocean Tuna	(Seychelles)

L'information a été recueillie au regard de toutes les formes d'énergie consommées à chaque usine et au regard d'interviews et discussions réalisées avec le personnel opérationnel qui ont permises de comprendre en détail les opérations de chaque section de chaque usine.

Des données de référence ont été établies à des fins d'analyse comparative. Ensuite, des évaluations de chaque secteur où une amélioration de l'efficacité énergétique pourrait être effectuée par des changements opérationnels ou par un renouvellement de l'équipement ont été réalisées.

En outre, des sources alternatives d'énergie ont été investiguées. La faisabilité de l'énergie éolienne et solaire comme étant des sources d'énergie renouvelable potentielle pour cet environnement a été considérée.

Des recommandations et des estimations de coûts ont été préparées. Les recommandations sont détaillées individuellement dans des rapports séparés pour chaque opérateur mais peuvent être résumées comme suit :

- En raison de la taille des usines et des quantités d'électricité requises dans chaque cas (1,5 MVA à 3 MVA), aussi bien l'énergie éolienne que l'énergie solaire ont été considérées comme inaptes. Ceci est dû aux implications économiques (capitaux et coûts de maintenance) et opérationnelles (espace et ressources techniques) de telles unités.
- En général, les usines ont été considérées comme relativement modernes avec un équipement suffisant et bien entretenu. Dès lors, les opportunités de réductions significatives d'énergie sont limitées. Cependant, dans au moins cinq des exploitations, un nombre de mesures pratiques d'améliorations peuvent être envisagées.
- Le plus grand potentiel en termes de réduction de consommation d'énergie serait de développer une relation en symbiose avec l'Autorité Nationale d'Electricité qui possède une centrale électrique à proximité des usines de transformation de thon (moins de 3km). Ces centrales électriques pourraient être modifiées pour intégrer des chaudières de récupération (échangeurs de chaleur) qui produiraient de la vapeur à partir de la chaleur résiduelle des turbines de gaz et/ou des gaz d'échappement et ensuite transférer cette vapeur aux points de demande. Cela éliminerait les besoins des usines de transformation du thon de produire leur propre vapeur. Les économies et les bénéfices pourraient donc être substantiels.
- Ce scénario pourrait être considéré comme tout ou partie d'un plan national stratégique pour une série d'industries.

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4. INTRODUCTION

The Implementation of Regional Fisheries Strategy was launched in February 2011 with the aim of contributing to the social, economic and environmental development in ESA-IO region through the sustainable exploitation of the fisheries resources.

Seven operating plants in the region, who are all members of the IOTOA, agreed to take part in this investigation namely:

Thon des Mascareignes	(Mauritius)
Marine Biotechnology Products	(Mauritius)
Mer des Mascareignes	(Mauritius)
Froid des Mascareignes	(Mauritius)
Pêche et Froid Océan Indien	(Madagascar)
Mauritius Freeport Development	(Mauritius)
Indian Ocean Tuna	(Seychelles)

Phase II or the operational phase of Project began in August 2011.

Phase II (a) covered the water and wastewater usage and phase 11(b), this report, covers the investigation into the energy usage.

Phase II (b) began on the 7th November 2011 and ended on 29th November 2011.

5. PURPOSE OF THE ASSIGNMENT

The purpose of the assignment for phase II (b) was to gather information of all forms of energy consumed at each plant, as well as gaining insight into their operations. Using this information the aim was to find ways of reducing the energy consumption through modifications to plant and equipment, possible use of alternative energy sources (ideally sustainable sources) and improvements to the energy efficiency of operations.

6. COMMENT ON THE ASSIGNMENT

A clear perspective needs to be maintained with regard to this assignment as in a number of cases, attempting

1. to reduce the impact the industry has on the environment in general and
2. to reduce the energy consumption in particular, may work against one another.

Examples of such competing environmental and energy objectives are:

- Improving the wastewater quality to meet international standards would require additional equipment and could increase the energy consumption.

- Reducing boiler stack emissions to meet international emission standards would usually need some form of gas scrubbing equipment to be installed in the flue gas ducts, which again would increase the energy consumption.

- Replacing normal light fittings with energy saving lamps would reduce energy consumption, but these lamps impact on the environment during disposal due to their high mercury content.

Thus in many cases the solution needs to be a compromise. In addition to balancing the reduction of energy consumption (carbon foot print) with other environmental issues, the economic aspects (capital and operating costs) need to be considered.

7. METHODOLOGY

An average of two days was spent at each plant, during which discussions were held with the operating and technical personnel and familiarisation tours of the facilities were conducted. All forms of energy consumed at each plant were investigated including on-site fossil fuel boilers producing steam for the process and electrical power consumption for refrigeration, plant power and lighting.

Energy consumption figures were collected and information gathered on the processes at each plant so that insights into the operations could be formed.

From this information an attempt was made to develop the energy consumption per unit output figures so as to provide benchmarking for comparison within the region and internationally.

Assessments were made at each plant and areas identified where internal improvements could be

made to reduce energy consumption either via operational changes or equipment replacement. In addition alternative sources of energy were investigated. With regard to sustainable energy sources, the investigation focused particularly on employing wind and/or solar energy equipment, as these are the most likely to be feasible for this environment.
Recommendations and estimated costs were prepared. The recommendations are detailed in the reports for each individual plant that was investigated.

8. ALTERNATIVE SUSTAINABLE ENERGY SOURCES

8.1 Wind

With today's technology, employing energy generated by means of wind turbines becomes practical and economic in either of two power bands, namely:

- Small power - less than 10 kW
- Large power - more than 10 MW

Small power wind sources generally employ a single wind turbine charging a set of 12V batteries that then via an inverter supply power to some form of domestic load, i.e. one or two lights, a television set, navigational equipment on yachts or a refrigerator. Costs are small and the technology is relatively uncomplicated and readily available

Large wind power sources are generally implemented by National Electricity Authorities or large private power companies selling power to the national grid. These wind turbines typically are about 80 m high and generate 2 to 2.5 MW each. Normally 5 to 20 (or more) are installed in a suitable area (often on mountain ridges). These turbines generate power directly into the grid at the required voltage and frequency without the need for batteries. Capital costs are very high and the technology extremely complicated.

The power requirements of the IOTOA member plants fall between these two power bands. The capacity of the 10kW wind turbine chargers are much too small for an industrial plant, while the erection of wind turbine(s) of sufficient capacity on site would be problematic in terms of space and potential conflict with the municipal by-laws. In addition the battery capacity required to service the plant loads would make this solution impractical. Capital, operational and maintenance costs would make this solution uneconomic in today's terms.

8.2 Solar

Almost identical comments can be made for a solar panel solution. Once again space, battery capacity and costs would make this solution uneconomical.

As an example a plant with a 1000 kW load would require 40,000 batteries (100 Amphr truck batteries) and 30,000m² in area (300m x 100m) Discussions held with officials of the Electricity Board of Mauritius indicated that they are soon to begin a study into the feasibility of installing wind or solar farms on suitable sites on the island. It would be best that these forms of sustainable energy sources be implemented by the National Authorities.

9. OTHER ENERGY SAVING MEASURES

9.1 Steam Efficiency

The usual measures taken to ensure steam efficiency in steam generation and distribution are insulation and lagging of all the high temperature equipment of a boiler, using waste heat to heat the boiler feed water to as close to 100ºC as possible before it enters the boiler itself, and heating up the fuel to about 80ºC to improve flow and combustibility.

In this regard, most factories are preheating their boiler feed water, but if the final gas exit temperature from the factories' boilers are > about 120oC, there are probably still opportunities for further thermal efficiency improvements by using this heat for other process streams. Such opportunities were not investigated during the factory visits but should be explored by management.

To ensure maximum efficiency of the steam usage, the process design should allow for vacuum to be applied to the cooking vessels. This lowers the boiling point of water, increases the pressure and temperature range and keeps the steam in a vapour state for longer. This ensures that the latent heat in the steam is available for the process for a longer period.

Alternatively, again employing vacuum, multiple effect evaporation should be used. The number of vapour phase/liquid phase cycles can then be maximized so as to recapture the latent heat of steam as many times as possible – achieving several evaporations from each kilogram of steam used.

This concept appears to be understood by the industry but not applied in some of the plants. As a result their steam requirement and hence fuel consumption is higher than necessary.

Retro-fitting the necessary equipment would need to be investigated by the plants concerned.

Definition of Latent Heat: this is the heat required to change the state of a substance at constant temperature.

In the case of water it takes 5 times as much heat energy to change a unit quantity of water at 100ºC to steam at 100ºC as it does to heat the same quantity of water from 0ºC to 100ºC.

9.2 Steam as an Energy Source provided by Others

There may be an opportunity to obtain process steam from another source, thereby removing the need for self-generated steam. This scenario becomes particularly favourable if this steam could be generated by waste heat and presents itself when the National Electricity Authority (NEA) has power plants nearby.

(This concept has been recommended by Bosch Projects on other projects which have similar energy issues, e.g. the Barbados Sugar and Ethanol Industry, which is currently considering the proposal.)

The NEA power plants generate electricity using alternators driven by HFO powered engines. The exhaust heat from these engines is at present wasted to atmosphere, but instead could be recovered through a waste heat boiler to produce steam which could then be piped to the processing plant. Distance between the two plants is the determining factor; a maximum practical distance would be about 3 km, which places all of the plants investigated in this report within feasible range for such an arrangement.

(Note that New York and Moscow reticulate superheated steam for kilometres throughout their cities)

Putting numbers to this scenario: assume a gas engine has an efficiency of 40% and a waste heat boiler 33%. Then taking a quantity of fuel that has an energy equivalent of 10 MW, the gas engine would convert this fuel to 4 MW of electrical power and 6 MW of (waste) heat energy. (If it is a gas turbine, 100% of the waste heat will be at 700°C and if a gas engine then 35% of the waste heat will be at 90°C and 25% will be at 450°C). The waste heat boiler will convert this waste heat energy to between 1 and 2 MW of steam energy which is equivalent to approximately 4/8 tons of process steam.

A tuna process plant typically uses about 8 tons of process steam per hour at 6/10 Bars gauge pressure.

Preliminary calculations were carried out and show that it is possible to transfer 10 t/h of steam at an initial pressure of 10 Bar along a 250 mm diameter pipe for 3 km with a pressure drop of 2 bars.

9.3 Steam Pressure

The boilers installed at the tuna processing plants have design pressures of 10 or 12 Bars. For maximum efficiency the boilers should be operated at these pressures. To operate these boilers at a lower pressure with a view to saving fuel energy is false economy.

The heat energy (enthalpy) in each kilogram of steam is a function of the pressure and temperature of the steam. While it is correct that, at a given boiler efficiency, slightly less fuel will be required to generate a kilogram of steam at a lower pressure / temperature, that kilogram of steam will contain less enthalpy to perform work – power generation, process heating or evaporation. Consequently, more kilograms of the lower pressure steam will be needed to perform the required process function. This extra steam will require extra fuel to generate it. In fact, because there is a fixed loss (from reheating cooled condensate) in each steam cycle, using lower pressure steam will use more fuel than using higher pressure steam.

9.4 Addition of a Small Amount of Water to the Boiler Fuel Oil

From the literature and from discussion with boiler suppliers in South Africa, installation of this equipment has considerable merit.

In this practice, an emulsified mixture of water and HFO is introduced into the boiler via the burner. With the addition of the furnace heat, the water molecules surrounded by oil molecules in the mixture immediately turn into steam, breaking up the oil molecules into much smaller molecules. These smaller molecules have a greater surface area which in turn allows for more complete combustion. This results in more efficient use of the fuel and lower emissions. It is important to control the preparation of the emulsified fuel mixture, using just sufficient water for the atomisation. Any more water will detract from overall efficiency as the excess water will absorb energy to be vaporised and heated to the final gas exit temperature.

Potential savings in HFO usage are reported to be between 10-15%. The stack emission will be reduced and may meet the international emission standard without the addition of additional equipment, which would be a further benefit.

9.5 Refrigeration Plants

The refrigeration equipment uses the majority of the electrical power consumed and it would make sense to try to make savings in this area.

The first focus must be on maintenance basics. The insulation and lagging must always be kept in good condition. The compressors, evaporators and condensers must be operating at peak efficiency and all the control and monitoring instrumentation must be working accurately.

Secondly, operational discipline has to be enforced, particularly with regard to the unnecessary and prolonged opening of cold room doors. A large amount of cooling energy can be lost here.
All the plants visited had numerous split unit air-conditioners for offices and there might be an opportunity to install a more efficient centralized unit using chillers where the chilled water is provided by spare capacity in the cold room refrigeration plant.

9.6 Lighting

The lighting load in the plants is small - possibly less than 5%. Nevertheless small savings can be made in this area by:

- Making use of daylight switches that turn off lights during the day if not required.
- Making better use of natural light by means of windows or translucent roof sheeting where applicable.
- Making wider use of white paint.
- Where possible replacing the fluorescent fittings with ones that have electronic ballasts.

10. DETAILS OF THE ENERGY INVESTIGATION CARRIED OUT AT THE INDIVIDUAL PLANTS

Separate reports have been prepared for each individual factory visited. These cover the above general issues as applicable to the factory concerned as well as any specific points relevant only to that plant.

11. RECOMMENDATIONS

The recommendations for each plant are detailed in the individual reports however the following is a summary of these recommendations.

- If HFO fuel is used in the boilers, water injection equipment (emulsifiers) should be installed. This improves combustion, thus not only reducing the fuel consumption but also reducing the stack emissions.
- Ensure that design of the process maximizes the efficient use of steam.
- Where the final gas exit temperature from a factory's boiler is > 120oC, investigate opportunities for using this to heat feed water or process streams.
- Investigate the possibility of obtaining steam from another source, particularly from the National Electricity Authority.
- Ensure that a Planned Maintenance Management System is in place, particularly for the refrigeration equipment.
- Investigate the possibility of using spare capacity from the cold room refrigeration units to supply chilled water for a centralized air-conditioning unit, replacing the split unit air-conditioners for the offices.
- Maintain operational discipline with regard to the cold rooms (close doors).
- Switch off unnecessary lighting.
- Initiate a programme to change to fluorescent fittings with electronic ballasts.
- Encourage clients/customers to take earlier delivery of their refrigerated containers, thereby reducing the electrical burden on the factories.
- Increase the use of electric fork lift vehicles.

12. ESTIMATED BUDGET

See details in reports on individual plants. However, some general comments are as follows:

Most of the recommended improvements are inexpensive and thus could be undertaken as part of the maintenance effort and within the maintenance budgets when the occasion permits.

The installation of emulsifying equipment could be implemented on a monthly rental basis which would be preferable if this equipment is initially installed on a trial basis.

Attempting to obtain a realistic budget for acquiring steam energy from the National Electricity Authorities would not be practical within the scope of this report. Being of national interest there are too many unknowns of a political, municipal, technical and financial nature which could only be obtained from a detailed feasibility report on the subject.

Nevertheless, an order of magnitude estimate for a project of this type can be made as follows:

- €0.5 million for the steam pipeline
- €0.5 million for the water pipeline
- €1.5 million for the waste heat boilers
- €1 million for ancillary equipment
- €0.5 million for contingencies

This totals €4 million which, taken over twenty years, would be insignificant compared to the saving in fuel cost alone.

Other advantages are:

- Discontinuation of the use of HFO
- Eventual shutting down of the boiler plant
- Eventual shutting down of the HFO storage, pumping and transfer equipment
- Removal of the potential fire hazard associated with HFO
- Removal of the potential pollution hazard associated with HFO
- Removal of the carbon emissions associated with the burning of HFO
- Reduction in boiler operating staff with reduction to the wage budget
- Reduction in the maintenance budget
- Reduction in the stores holding
- Reduction in the electricity consumption

The project expenditure for this would be a once off capital cost with negligible operating and maintenance costs. The only ongoing costs would be costs associated with producing quality water and the costs of buying the steam. As this steam is essentially a by-product of the power utility, it should be possible to negotiate a minimal purchase cost (in comparison to the cost of HFO).

13. BENCHMARKING INDICES

A number of attempts have been made at developing energy indices which could be used as benchmarks throughout the industry.

A report on the seafood industry in Thailand gives the following figures:

	Typical	Target
Power consumption in kWh per ton of fish	22 – 279	36.7
Fuel (HFO) consumption litres per ton of fish	71 – 174	174

A report on the canning industry based on figures from the UNEP report gives the following figures

Power consumption in kWh per ton of fish	150 -190

As can be seem there would appear to be quite a wide range and figures obtained from the seven plants visited show similar variances. This is understandable as the plants have marked differences in the type of production, factory layouts, process design and process equipment, all of which would affect the energy usage. This limits the usefulness of these indicators as tools for comparisons.

Some work has been done internationally on attempting to measure the electrical consumption during each part of the process in terms of the ISO 14000 initiative. To do this successfully the electrical reticulation has to be modified so that measuring instruments installed are able to measure the consumption of each section independently. This work is still in the process of being undertaken at the plants visited.

At this stage a more practical measure would be for each factory to take note of its present consumption and compare it with estimated future consumption after energy saving measures has been implemented.

14. IMPLEMENTATION PLAN

Apart from the project of obtaining steam from the National Electricity Authorities, the recommended energy saving measures are small projects, generally inexpensive and could easily be carried out within the maintenance budgets as soon as time permits.

The project recommendation for obtaining steam from the National Electricity Authorities would require a lengthy time frame, probably beginning with negotiations at government level to obtain acceptance in principle of this recommendation. This would be followed by a feasibility study which would look at all the aspects of the project to confirm its viability and to identify and address potential problem areas. The next step would be detailed design and pipeline servitude negotiations followed by drawing up of contract documents, tender process, adjudication and awarding of the contract(s).

APPENDIX

ANNEX 1: PROGRAMME AND CONTACT PERSONS

Date	Day	Place	Contact Persons
2011/07/11	Monday	Fly to Mauritius via JHB	
2011/08/11	Tuesday	Initial meeting and orientation TDM	Mr. Chris Short, Mrs Veronique Garrioch
2011/09/11	Wednesday	Thon Des Mascareignes (TDM)	Mr. Mario Genevieve (Maintenance Manager), Mr Amit Rajpugh (Electrical Engineer)
2011/10/11	Thursday	Thon Des Mascareignes (TDM)	
2011/11/11	Friday	Marine Biotechnology Products (MBP)	Mr. Yves Le Mao (General Manager),Mr Terrence Brown (Operations Manager), Mr Dariusz Marczkr (Maintenance Manager)
2011/12/11	Saturday		
13/11/2011	Sunday		
14/11/2011	Monday	Marine Biotechnology Products (MBP)	
15/11/2011	Tuesday	Mer Des Mascareignes (MDM)	Chris Talbot (General Manager), Madhu Potharala (Maintenance Manager)
16/11/2011	Wednesday	Froid Des Mascareignes (FDM)	Maurice Rault (Managing Director), Bartrand Koenig (Project Manager), Cleret Alcindor (Maintenance Manager)
17/11/2011	Thursday	Froid Des Mascareignes (FDM)	
18/11/2011	Friday	Fly to Diego Via Reunion	
19/11/2011	Saturday	Peche et Froid Ocean Indien	
20/11/2011	Sunday		
21/11/2011	Monday	Peche et Froid Ocean Indien	Henri Louis (General Manager) Rodolphe (Maintenance Manager)
22/11/2011	Tuesday	Fly to Mauritius via Antananarivo	
23/11/2011	Wednesday	Mauritius Freeport Development (MFD)	Domonique de Froberville (CEO) Jacques Pelicier (Maintenance Manger)
24/11/2011	Thursday	Mauritius Freeport Devel-opment (MFD)	
25/11/2011	Friday	Discuss draft report	
26/11/2011	Saturday	Fly to Seychelles via Reunion	

27/11/2011	Sunday		
28/11/2011	Monday	Indian Ocean Tuna	Joram Madnack (General Manager), Charles De Clarise (Engineering Manager)
29/11/2011	Tuesday	Indian Ocean Tuna	
30/11/2011	Wednesday	Fly to Durban via Dubai	

ANNEX 2: TERMS OF REFERENCE

AGROTEC CONSORTIUM Agrotec	
Assignment Name	
Mission Schedule Number	4M2.3.1a-TOR
Coordinator	Chris Short, KE3; Coordinator of RESULT 4: Regional Trade Strategy
Technical Verifier	Chris Short, KE3; Coordinator of RESULT 4: Regional Trade Strategy
Background to assignment	The IRFS program was launched in February 2011 with the aim of contributing to an increased level of social, economic and environmental development and deeper regional integration in the ESA-IO region through the sustainable exploitation of fisheries resources. The program is financed by the European Union under the 10th European Development Fund within a total financial contribution of Euro 21 million. The program is implemented by the Indian Ocean Commission (IOC) in collaboration with the Common Market for East and Southern Africa (COMESA), the East Africa Community (EAC) and the Inter-Governmental Authority on Development (IGAD). Other regional institutions involved include the Southern African Development Community (SADC) and regional fisheries management organizations, such as the Indian Ocean Tuna Commission (IOTC), the Southwest Indian Ocean Fisheries Commission (SWIOFC), the Lake Victoria Fisheries Organization (LVFO), and the Lake Tanganyika Fisheries Organization (LTFO). The first phase of the Program will be implemented over a period of 31 months (March 2011-September 2013). The overall objective of the program is to contribute to an increased level of social, economic and environmental development and deeper regional integration in the ESA-IO region through the sustainable exploitation of fisheries resources. The expected results and outcome of the program falls into the following five categories: fisheries governance; fisheries management; monitoring, control and surveillance; regional fish trade and food security. This assignment falls under the Result 4 (regional fish trade component) of the project. The development of a regional trade strategy is the thrust of the program. This will be implemented through national and regional level trade and marketing approaches and regional consensus to support strategy development. The traditional focus on large international trading blocks has reduced efforts from developing a regional trade approach. Regional trade holds great potential for development and will be examined within this program and integrated with strategic marketing plans at the regional and national level. Many national and regionally driven and oriented activities will develop objective requirements for achieving this goal. Marketing strategies will be prepared at the national level and a comprehensive understanding of existing and potential trade, especially intra-regionally, will be required. This data will ensure regional trade strategies meet the requirements of the

	beneficiary countries and that trade potential is fully understood. This assignment follows on from a previous assignment that looked at eco-certification for the Indian Ocean Tuna Operators Association (IOTOA). Background to this activity TOR for phase II of IOTOA pre-assessment work - following the first pre-assessment for eco-certification in the Indian Ocean completed at the end of May 2011 and some recommendations coming from that assessment report, the Association is now interested to continue with priority environmental aspects of post harvest members of the association (approximately 8 manufacturers in Mauritius, Seychelles and Madagascar). The objective is to advise the members on potential to improve facility operations in the areas of water usage / waste water handling as well as energy usage: - Environmental assessments of 8 plants in the Indian Ocean with the IOTOA group with a focus on water usage, wastewater handling and energy usage. The plants are as follows: 1. location in Mauritius 2. B location in Mauritius 3. C location in Mauritius 4. D location in Mauritius 5. E location in Mauritius 6. F location in Mauritius 7. G location in Seychelles 8. H location in Madagascar - Identification and recommendations for appropriate international standards (such as ISO) that can be planned for and achieved by the members and outline the process to achieve such standards
Issues to be addressed	The specific task is to: With a focus on three countries – Mauritius, Seychelles and Madagascar, an appropriately detailed assessment of facility processes involving water and energy is required. 1 Senior industrial water engineer and 1 senior energy / alternative energy specialist is required. An environmental standards specialists (such as ISO) is required, if these others specialists are not knowledgeable in the subject – ideally one of the experts would fit that role also.
Activities of the Consultant	The experts (2) shall perform the following tasks: • Visit 3 countries of the Indian Ocean, namely Madagascar, Mauritius and Seychelles and meet with the industry and the authorities with regards to an eco-certification scheme for the tuna industry. To be accompanied WATER - In the context of the overall Mauritius water sector performance and expected performance assess water usage for each of the 8 plants listed above. - Assess and describe at a detailed level processes related to water: sources, usage, storage and distribution systems at each plant - Review potential for reduction, re-use, recycling, re-structuring of water usage within each facility related to their current usages and processes employed - Make recommendations for changes to industrial process at the plant level for improvements that will be effective and efficient if undertaken - Estimate budget cost implications (+ or -) for making various improvements recommended

	- Identify achievable international standards for water usages and wastewater handling that are appropriate to the facilities - Provide outline of roadmap to describe the process to achieve such standards ENERGY - Assess and describe at a detailed level energy usage at each plant - Review potential for reduction of energy usage, alternative sources of energy (solar, wind, energy saving techniques, etc.) within each facility related to their current usages and processes employed - Make recommendations for changes to industrial process / efficiency to achieve energy savings - Estimate budget cost implications (+ or -) for making various improvements recommended - Identify achievable international standards for water usages and wastewater handling that are appropriate to the facilities - Provide outline of roadmap to describe the process to achieve such standards Prepare a report that details the findings of the study and present findings at a de-briefing for selected IOTOA members to be organized at the end of the mission.
Expected outputs	The Expert shall produce a report demonstrating the work done, namely: a) Comprehensive report detailing all aspects with respect to the tasks above b) Table of Contents for the report to be verified as a first step with technical coordinator (KE3) to ensure balance of report and areas of emphasis The report to be produced using MS Word (and other MS Office software if necessary) and be available in hard copy and electronic form, both in Word (and other MS Office Programmes as appropriate) and all the elements together in single file pdf format.
Format of each report	- MS Word Styles for IRFS Programme Reports and Technical Papers - Structure - Title pages in model format as per other Programme Reports – to be supplied - Table of contents, to three levels, formal format – to be agreed - List of annexes if appropriate - Tables of tables, figures and pictures all formal format - Abbreviations and acronyms - Layman's summary (one paragraph encapsulating key elements that can be used in magazine/web i.e. not over technical) - Executive Summary (1 to 2 pages), in English, and French - Introduction - Main body of report divided into different sections as appropriate, normally Context, Methodology, Performance in relation to TOR, and Discussion (up to 20 pages) - Conclusions and recommendations (each recommendation must be preceded by a conclusion, that refers to a discussion in the main body of the report) - Annex 1 Terms of reference (if appropriate) - Annex 2 Schedule and people met (with contacts) - Any other annex(es) as appropriate
Report to be reviewed by	Chris Short, KE3 for Trade Result

	(iii) Travel to Seychelles	1
	(iv) Meet with stakeholders (processing plant) to review facility processes, report drafting	2
	(v) Travel to Madagascar	1
	(vi) Meet with stakeholders (processing plant) to review facility processes, report drafting	2
	(vii) Travel to Mauritius	1
	(viii) Prepare draft report during visits and continue in Mauritius following all plant visits	3
	(ix) Discuss and present draft report at de-briefing with IOTOA Stakeholder representatives	1
	(x) Travel to home base	2
	(xi) Finalize report incorporating detailed as required and comments received from stakeholder briefing	2
	Total	26
	Total input days: 26 working days	
Start date	Approx:	Start July 2011
Completion dates for Reports and fee payment schedule	Draft report	Whilst on Mission
	Comments from PCM	Within 1 week after de-briefing
	Final report	Within 1 week after de-briefing
	Final report basis for relevant payments	
Experience and qualification	Senior Engineer Qualifications and skills: - fluency in one of French or English and working knowledge of other - Demonstrated experience with industrial plant water / wastewater engineering processes preferably in the food processing/ fisheries sector - Experience working with EU projects an advantage - Ability to travel and work in ACP countries	
Locations and travel	Mauritius base + travel in region as required: Travel from: (Home base) to Mauritius; to Seychelles; to Madagascar; return to Mauritius; to (Home base)	

LIST OF PUBLICATIONS – LISTE DES PUBLICATIONS

SmartFish Programme

1. *Report of the Inception / Focal Point Meeting of the SmartFish Programme – Flic en Flac, Mauritius, 15th-16th June 2011.* REPORT/RAPPORT: SF/2011/01. August/Août 2011. SmartFish Programme. Indian Ocean Commission.

2. *Report of the First Steering Committee Meeting of the SmartFish Programme – Flic en Flac, Mauritius,17th June 2011.* REPORT/RAPPORT: SF/2011/02. August/Août 2011. SmartFish Programme Indian Ocean Commission.

3. *Rapport de la réunion de présentation du programme SmartFish aux points focaux – Flic en Flac, Ile Maurice, 15-16 juin 2011.* REPORT/RAPPORT: SF/2011/03. August/Août 2011. SmartFish Programme. Indian Ocean Commission.

4. *Eco-Certification for the Tuna Industry, Technical Assistance for Implementation of a Regional Fisheries Strategy for ESA-IO (IRFS).* REPORT/RAPPORT: SF/2011/04. May 2011. SmartFish Programme. Indian Ocean Commission.

5. *Regional Market Assessment (Supply and Demand).* REPORT/RAPPORT: SF/2012/05. March/Mars 2012. SmartFish Programme. Indian Ocean Commission.

6. *Trade Assessment Study.* REPORT/RAPPORT: SF/2012/06. March/Mars 2012. SmartFish Programme. Indian Ocean Commission.

7. *Gouvernance des Pêches Maritimes dans l'Ouest de l'Océan Indien.* REPORT/RAPPORT: SF/2012/07. June/Juin 2012. SmartFish Programme. Indian Ocean Commission.

8. *Value Chain Assessment of the Artisanal Fisheries – Mauritius.* REPORT/RAPPORT: SF/2012/08. June/Juin 2012. SmartFish Programme. Indian Ocean Commission.

9. *Kenya Fisheries Governance.* REPORT/RAPPORT: SF/2012/09. June/Juin 2012. SmartFish Programme. Indian Ocean Commission.

10. *Training Needs Analysis – Quality and Hygiene:* REPORT/RAPPORT: SF/2012/10. June/Juin 2012. SmartFish Programme. Indian Ocean Commission.

11. *A Review of Somalia's & (Semi-Autonomous Regions) Fisheries Legislation and Management.* REPORT RAPPORT: SF/2012/11. June/Juin 2012 SmartFish Programme. Indian Ocean Commission.

12. *Assessment of IUU Activities On Lake Victoria.* REPORT/RAPPORT: SF/2012/12. June/Juin 2012 SmartFish Programme. Indian Ocean Commission.

13. *Review Of The Legal Framework for the ESA-IO Region.* REPORT/RAPPORT: SF/2012/13. June/Juin 2012 SmartFish Programme. Indian Ocean Commission.

14. *Comprehensive capacity review to implement effective MCS in the ESA-IO Region.* REPORT/RAPPORT: SF/2012/14. June/Juin 2012 SmartFish Programme. Indian Ocean Commission.

15. *Assessment of IUU Fishing in Lake Tanganyika.* REPORT/RAPPORT: SF/2012/15. June/Juin 2012 SmartFish Programme. Indian Ocean Commission.

16. *Spirulina – A Livelihood and a Business Venture.* REPORT/RAPPORT: SF/2012/16. SmartFish Programme. June/Juin 2012 Indian Ocean Commission.

17. *Diversification Study (Eco-Tourism and Recreational Fisheries).* REPORT/RAPPORT: SF/2012/17. June/Juin 2012 SmartFish Programme. Indian Ocean Commission.

18. *Value Chain Analysis of Fisheries Sector for Rodrigues.* REPORT/RAPPORT: SF/2012/18. June/Juin 2012 SmartFish Programme. Indian Ocean Commission.

19. *Dagaa Value Chain Analysis and Proposal for Trade Development.* REPORT/RAPPORT: SF/2012/19. June/Juin 2012 SmartFish Programme. Indian Ocean Commission.

20. *Operationalization of Fish Auction Market. (Feasibility Study).* REPORT/RAPPORT: SF/2011/20. December/Décembre 2011 SmartFish Programme. Indian Ocean Commission.

21. *Options to Reduce IUU Fishing in Kenya, Tanzania, Uganda and Zanzibar:* REPORT/RAPPORT: SF/2012/21. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

22. *Revitalization of Fisheries Research in Mauritius.* REPORT/RAPPORT: SF/2012/22. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

23. *Preparation of Draft Kenya Fisheries Management and Development Bill:* REPORT/RAPPORT: SF/2012/23. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

24. *Une Analyse Globale de la Chaîne D'approvisionnement de la Pêcherie du Crabe de Mangrove (Scylla serrate) à Madagasar.* REPORT/RAPPORT: SF/2012/24. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

25. *Analyse Globale de la Gouvernance et de la chaîne D'approvisionnement de la Pêcherie du concombre de mer à Madagasar.* REPORT/RAPPORT: SF/2012/25. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

26. *Processing and Marketing of Small-Sized Pelagics in Eastern and Southern Africa.* REPORT/RAPPORT: SF/2012/26. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

27. *Report of the Second Steering Committee Meeting of the SmartFish Programme.* REPORT/RAPPORT: SF/2011/27. August/Août 2012. SmartFish Programme Indian Ocean Commission.

28. *The Farming of Seaweeds.* REPORT/RAPPORT: SF/2011/28. August/Août 2012. SmartFish Programme Indian Ocean Commission.

29. *Culture d'Algues Marines.* REPORT/RAPPORT: SF/2011/29. August/Août 2012. SmartFish Programme Indian Ocean Commission.

30. *Report of the Focal Point Meeting of the SmartFish Programme – Livingstone, Zambia, 28th – 29th February 2012.* REPORT/RAPPORT: SF/2011/30. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

31. *Appui a l'Elaboration d'une Strategie Nationale de Bonne Gouvernance des Peches Maritimes a Madagascar.* REPORT/RAPPORT: SF/2013/31. June/Juin 2012 SmartFish Programme. Indian Ocean Commission.

32. *A Review of Bycatch and Discard Issues in Indian Ocean Tuna Fisheries.* REPORT/RAPPORT: SF/2013/32. 2012 SmartFish Programme. Indian Ocean Commission.

33. *The Feasibility of Aquaponics in Mauritius.* REPORT/RAPPORT: SF/2013/33. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

34. *National Governance and Value Chain Analysis of Shark Fisheries in Madagascar.* REPORT/RAPPORT: SF/2013/34. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

35. *Partners Meeting on Fisheries Strategy for the Esa-Io Region.* REPORT/RAPPORT: SF/2012/35. July/Julliet 2013 SmartFish Programme. Indian Ocean Commission.

36. *Potential for Energy Saving Measures in the Tuna Industry in the Southern Eastern Indian Ocean Region.* REPORT/RAPPORT: SF/2013/36. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

La bonne gouvernance et de la gestion des pêches et de l'aquaculture permettent d'améliorer la contribution du secteur à la sécurité alimentaire, au développement social, à la croissance économique et au commerce régional ; ceci en assurant par ailleurs une protection renforcée des ressources halieutiques et de leurs écosystèmes.

La Commission de l'Océan Indien (COI) ainsi que la COMESA (Common Market for Eastern and Southern Africa), l'EAC (East African Community) et l'IGAD (Inter-Governmental Authority on Development) ont développé des stratégies à cette fin et se sont engagés à promouvoir la pêche et l'aquaculture responsable.

SmartFish supporte la mise en œuvre de ces stratégies régionales en mettant l'accent sur le renforcement des capacités et des interventions connexes visant à :

- mettre en place des mécanismes pour la gestion et le développement durable des pêches ;
- développer un cadre de gouvernance des pêches au niveau régional ;
- renforcer le suivi-contrôle-surveillance pour les pêcheries partagées ;
- développer des stratégies et supporter des initiatives propres à accroître le commerce régional du poisson ;
- contribuer à la sécurité alimentaire en particulier par la réduction des pertes après captures et la diversification de la production.

SmartFish est financé par l'Union Européenne dans le cadre du 10ème Fond Européen de Développement.

SmartFish est mis en œuvre par la COI en partenariat avec la COMESA, l'EAC et l'IGAD et en collaboration avec la SADC. Une collaboration étroite a également été développée avec les organisations régionales de pêche de la région. L'assistance technique est fournie par la FAO et le consortium Agrotec SpA.

By improving the governance and management of our fisheries and aquaculture development, we can also improve food security, social benefits, regional trade and increase economic growth, while also ensuring that we protect our fisheries resources and their ecosystems.

The Indian Ocean Commission (IOC), the Common Market for Eastern and Southern Africa (COMESA), the East African Community (EAC) and the Inter-Governmental Authority on Development (IGAD) have developed strategies to that effect and committed to regional approaches to the promotion of responsible fisheries and aquaculture.

SmartFish is supporting the implementation of these regional fisheries strategies, through capacity building and related interventions aimed specifically at:

- implementing sustainable regional fisheries management and development;
- initiating a governance framework for sustainable regional fisheries;
- developing effective monitoring, control and surveillance for transboundary fisheries resources;
- developing regional trade strategies and implementing regional trade initiatives;
- contributing to food security through the reduction of post harvest losses and diversification.

SmartFish is financed by the European Union under the 10th European Development Fund.

SmartFish is implemented by the IOC in partnership with the COMESA, EAC, and IGAD and in collaboration with SADC. An effective collaboration with all relevant regional fisheries organisations has also been established. Technical support is provided by Food and Agriculture Organization (FAO) and the Agrotec SpA consortium.

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