

REQUEST FOR PROPOSALS

TECHNICAL ASSISTANCE FOR THE

HPCL ASSET INTEGRITY MANAGEMENT PROJECT

Submission Deadline: **4:00 PM**

LOCAL TIME

JUNE 11, 2008

Submission Place: Mr. S. C. Mehta
General Manager—Technical, Mumbai Refinery
Hindustan Petroleum Corporation Ltd.
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Mahul, Mumbai 400-074
India
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SEALED PROPOSALS SHALL BE CLEARLY MARKED AND RECEIVED PRIOR TO THE TIME AND DATE SPECIFIED ABOVE. PROPOSALS RECEIVED AFTER SAID TIME AND DATE WILL NOT BE ACCEPTED OR CONSIDERED.

REQUEST FOR PROPOSALS

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Section 1: INTRODUCTION

The U.S. Trade and Development Agency (USTDA) has provided a grant to the Grantee, Hindustan Petroleum Corporation Limited (HPCL) for Technical Assistance on an Asset Integrity Management Project in India. The grant agreement is attached at Annex 4 for reference. The Grantee is soliciting technical proposals from qualified U.S. firms to provide expert consulting services to carry out the Technical Assistance.

1.1 BACKGROUND SUMMARY

HPCL is seeking to develop a comprehensive program of Asset Integrity Management (AIM) for its petroleum refineries and associated pipelines. HPCL is a large public sector company in India whose core business is the refining of crude oil and the marketing of petroleum products. HPCL operates two large refineries in Mumbai on the west coast and Visakhapatnam (Visakh) on the east coast with a combined refining capacity of 13 MMTPA (million tons per annum). This accounts for about ten percent of India's current refining capacity. HPCL also has equity interest in a refinery in Mangalore, and is currently developing a new refinery in Punjab. Plans call for the expansion of its refining capacity to 23 MMTPA.

The Technical Assistance would examine both of HPCL's refineries and train HPCL personnel on a comprehensive strategy for evaluating risk to petroleum refineries and related facilities, and on a wide range of advanced technologies available from the United States. A number of these technologies will be demonstrated at HPCL's Mumbai refinery. The training and field demonstrations will be open to select individuals from other Indian refining companies and also to the Oil Industry Safety Directorate (OISD), which is the safety regulatory body for refineries, pipelines and storage facilities under the Ministry of Petroleum and Natural Gas. OISD has indicated that, based on the results of this Technical Assistance, it would consider modifying standards and regulations regarding inspections to have refiners apply these new methodologies and technologies to other refineries throughout India.

The objectives of an AIM system are the delivery of business requirements maximizing return on assets while maintaining stakeholder value and minimizing business risks associated with accidents and loss of production. Asset Integrity is the ability of an asset to perform its required function effectively and efficiently while safeguarding life and the environment. The related management activities ensure that the people, systems, processes and resources that deliver integrity, are in place, in use and fit for purpose over the whole lifecycle of the asset. HPCL and the other petroleum refining companies are more sensitized to the need to improve inspection services throughout the refinery, including process units (pressure vessels) storage tanks, and piping to avoid the consequences similar to that arising from the Texas City refinery disaster which has been attributed by U.S. regulators and independent studies to non-compliant lax practices and excessive cutbacks in investment for inspection and maintenance. OISD supports the refining industry augmenting safety practices and adopting new proven cost effective technologies.

A background Definitional Mission is provided for reference in Annex 2.

1.2 OBJECTIVE

HPCL wishes to establish a comprehensive AIM program in accordance with evolving world class best practices. The adoption of new technologies and methodologies in safety inspection and refinery maintenance will: (1) enhance HPCL's capability to maintain reliable refinery throughput to meet growing domestic market requirements for petroleum products; (2) improve energy security by minimizing the risks of catastrophic outages to its infrastructure and operations which would seriously reduce oil product supplies to its customers; (3) provide more cost effective solutions, and (4) develop the knowledge and skill sets of its workforce.

The Terms of Reference (TOR) for this Technical Assistance is attached as Annex 5.

1.3 PROPOSALS TO BE SUBMITTED

Technical proposals are solicited from interested and qualified U.S. firms. The administrative and technical requirements as detailed throughout the Request for Proposals (RFP) will apply. Specific proposal format and content requirements are detailed in Section 3.

COST will not be a factor in the evaluation and therefore, cost proposals should not be submitted; upon detailed evaluation of technical proposals, one firm will be selected for contract negotiations. The amount for the negotiated contract has been established by a USTDA grant of U.S. \$628,926.

1.4 CONTRACT FUNDED BY USTDA

The negotiated contract will be funded by USTDA in accordance with the terms and conditions of its grant to the Grantee. The contract must include certain USTDA mandatory clauses relating to nationality, taxes, payment, reporting, and other matters. The USTDA nationality requirements and the USTDA mandatory clauses are attached at Annexes 3 and 4 for reference.

Section 2: INSTRUCTIONS TO PROPOSERS

2.1 PROJECT TITLE

The project is called the "HPCL Asset Integrity Management Project."

2.2 DEFINITIONS

Please note the following definitions of terms as used in this RFP.

The term "Request for Proposals" means this solicitation of a formal technical proposal including qualifications statement.

The term "Offeror" means the U.S. individual, or U.S. firm, including any and all subcontractors, which responds to the RFP and submits a formal proposal and which may or may not be successful in being awarded this procurement.

2.3 DEFINITIONAL MISSION REPORT

USTDA sponsored a Definitional Mission to address technical, financial, sociopolitical, environmental and other aspects of the proposed project. A copy of the Report is attached at Annex 2 for background information only.

2.4 EXAMINATION OF DOCUMENTS

Offerors should carefully examine this RFP. It will be assumed that Offerors have done such inspection and that through examinations, inquiries and investigation they have become familiarized with local conditions and the nature of problems to be solved during the execution of the Technical Assistance.

Offerors shall address all items as specified in this RFP. Failure to adhere to this format may disqualify an Offeror from further consideration.

Submission of a proposal shall constitute evidence that the Offeror has made all the above mentioned examinations and investigations, and is free of any uncertainty with respect to conditions which would affect the execution, and completion of the Technical Assistance.

2.5 PROJECT FUNDING SOURCE

The Technical Assistance will be funded under a grant from USTDA. The total amount of the grant is not to exceed U.S. \$628,926.

2.6 RESPONSIBILITY FOR COSTS

Offeror shall be fully responsible for all costs incurred in the development and submission of the proposal or any other cost incurred by Offeror prior to issuance of an agreement or contract. Neither USTDA nor the Grantee assumes any contractual obligation as a result of the issuance of this proposal request, the preparation or submission of a proposal by an Offeror, the evaluation of proposals, or final selection.

2.7 TAXES

Offerors should submit proposals which note that in Annex 4, USTDA Mandatory Contract Provisions, USTDA funds are not to be used to pay taxes or duties under the laws of host country.

2.8 CONFIDENTIALITY

The Grantee will use its best efforts to preserve the confidentiality of any business proprietary or confidential information submitted by the Offeror, which is clearly designated as such by the Offeror.

2.9 ECONOMY OF PROPOSALS

Proposal documents should be prepared simply and economically, providing a comprehensive and concise description of the Offeror's capabilities to satisfy the requirements of the RFP. There is no necessity for expensive bindings, colored displays, or other promotional material unless such material is absolutely pertinent to the proposal. Emphasis should be placed on completeness and clarity of content.

2.10 SUBSTANTIVE PROPOSALS

The Offeror shall certify (a) that its proposal is genuine and is not made in the interest of, or on the behalf of, any undisclosed person, firm, or corporation, and is not submitted in conformity with, and agreement of, any undisclosed group, association, organization, or corporation; (b) that it has not directly or indirectly induced or solicited any other Offeror to put in a false proposal; (c) that it has not solicited or induced any other person, firm, or corporation to refrain from submitting a proposal; and (d) that it has not sought by collusion to obtain for himself any advantage over any other Offeror or over the Grantee or USTDA or any employee thereof.

2.11 CONDITIONS REQUIRED FOR PARTICIPATION

Only U.S. firms are eligible to participate in this tender. However, U.S. firms may utilize subcontractors from host country for up to 20 percent of the amount of the USTDA grant. USTDA nationality requirements are detailed in Annex 3.

2.12 LANGUAGE OF PROPOSAL

All proposal documents shall be prepared and submitted in English, and only English.

2.13 PROPOSAL SUBMISSION REQUIREMENTS

The **Cover Letter** in the proposal must be addressed to:

Mr. S. C. Mehta
General Manager—Technical, Mumbai Refinery
Hindustan Petroleum Corporation Ltd.
B.D. Patil Marg
Mahul, Mumbai 400-074
India

Phone: +011 91 22 2554 3482

Fax: +011 91 22 2554 4584

An Original and eight (8) copies of your proposal must be received at the above address no later than 4:00 PM (Local Time) on June 11, 2008.

Proposals may be either sent by mail, overnight courier, or hand-delivered. Whether the proposal is sent by mail, courier or hand-delivered, the Offeror shall be responsible for actual delivery of the proposal to the above address before the deadline. Any proposal received after the deadline will be returned unopened.

Upon timely receipt, all proposals become the property of the Grantee.

2.14 PACKAGING

Each proposal must be sealed to ensure confidentiality of the information. The proposals should be individually wrapped and sealed, and labeled for content including "original" or "copy number x"; the original and eight (8) copies should be collectively wrapped and sealed, and clearly marked for content.

Neither USTDA nor the Grantee will be responsible for premature opening of proposals not properly labeled.

2.15 AUTHORIZED SIGNATURE

The proposal must contain the signature of a duly authorized officer or agent of the Offeror empowered with the right to bind the Offeror.

2.16 EFFECTIVE PERIOD OF PROPOSAL

The proposal shall be binding upon the Offeror for sixty (60) days after the proposal due date, and Offeror may withdraw or modify this proposal at any time prior to the due date upon written request, signed in the same manner and by the same person who signed the original proposal.

2.17 EXCEPTIONS

Firms agree by their response to the RFP announcement to abide by the procedures set forth therein. Material modifications in the TOR or responsibilities of the parties will not be accepted.

Any exceptions in the proposal shall be clearly identified, and shall include the scope of such exception, and its impact, on the procurement. The Grantee shall make final determination as to the responsiveness of such exceptions and their acceptability.

2.18 OFFEROR QUALIFICATIONS

As provided in Section 3, Offerors shall submit evidence that they have relevant past experience and have previously delivered advisory and Technical Assistance services similar to those required in the TOR.

2.19 RIGHT TO REJECT PROPOSALS

The Grantee reserves the right to reject any and all proposals and to accept or reject any or all of the items in the proposal, and to award the contract in whole or in part if it is deemed in the best interest of the Grantee.

2.20 PRIME CONTRACTOR RESPONSIBILITY

Offerors have the option of subcontracting parts of the services they propose. The Offeror's proposal must include a description of any anticipated subcontracting arrangements, including the name, address, and qualifications of consultants and subcontractors. USTDA nationality provisions are set forth in detail in Annex 3. The successful Offeror shall cause appropriate provisions of its contract, including all mandatory USTDA clauses, to be inserted in all subcontracts ensuing to ensure fulfillment of all contractual provisions by subcontractors.

2.21 AWARD

An award resulting from this RFP shall be made to the best qualified Offeror, taking into consideration the evaluation factors set forth herein; however, the right is reserved to reject any

and all proposals received and, in all cases, the Grantee will be the judge as to whether a proposal has or has not satisfactorily met the requirements of this RFP.

2.22 COMPLETE SERVICES

The successful Offeror shall be required to (a) furnish all supplies, supervision, transportation, and other execution accessories, services, and facilities; (b) provide and perform all necessary labor; and (c) in accordance with good technical practice, with due diligence, and in accordance with the requirements, stipulations, provisions and conditions of this RFP and the resultant contract, execute and complete all specified work to the satisfaction of the Grantee.

2.23 INVOICING AND PAYMENT

Deliverables under the contract shall be delivered on a schedule to be agreed upon in a contract with the Grantee. The Contractor may submit invoices to the designated Grantee Project Director in accordance with a schedule to be negotiated and included in the contract. Upon approval of each invoice, the Grantee will forward the invoice to USTDA which will process payment to the Contractor. All payments by USTDA under the Grant Agreement will be made in U.S. currency.

Section 3: PROPOSAL FORMAT AND CONTENT

To expedite proposal review and evaluation, and to assure that each proposal receives the same orderly review, all proposals must follow the format described in this section.

Proposal sections and pages shall be appropriately numbered and the proposal shall include a Table of Contents. Offerors are encouraged to submit concise and clear responses to the RFP. Proposals shall contain all elements of information requested without exception. Instructions regarding the required scope and content are given in this section. The Grantee reserves the right to include any part of the selected proposal in the final contract.

The proposal shall consist of a technical proposal only. No cost proposal is required as the value of the USTDA grant is established at U.S. \$628,926.

Offerors shall submit one (1) original and eight (8) copies of the proposal. Proposals received by fax cannot be accepted.

The following sections and content are required for each proposal:

- Transmittal Letter,
- Cover/Title Page,
- Table of Contents,
- Introduction and Executive Summary,
- Company Information,
- Organizational Structure, Management Plan, and Key Personnel,
- Technical Approach and Work Plan,
- Experience and Qualifications, and
- Miscellaneous.

Detailed requirements and directions for the preparation of each section are presented below.

3.1 SECTION 1: INTRODUCTION AND EXECUTIVE SUMMARY

An Executive Summary should be prepared describing the major facts or features of the proposal, including any conclusions, assumptions, and generalized recommendations the Offeror desires to make. Offerors are requested to make every effort to limit the length of the Executive Summary to no more than five (5) pages.

3.2 SECTION 2: COMPANY INFORMATION

3.2.1 Company Profile

Provide the information listed below relative to the Offeror's firm. If the Offeror is proposing to subcontract some of the proposed work to another firm(s), similar information must be provided for each subcontractor. Offerors are requested to limit the length of the Company Profile Information to one (1) page per firm.

1. Name of firm and business address, including telephone and fax numbers.
2. Year established (include former firm names and year established, if applicable).
3. Type of ownership and parent company, if any.
4. Project Manager's name, address, telephone and fax number, if different from (1).

3.2.2 Offeror's Authorized Negotiator

Provide name, title, address, telephone and fax number of the Offeror's authorized negotiator. The person cited shall be empowered to make binding commitments for the Offeror and its subcontractors, if any.

3.2.3 Negotiation Prerequisites

1. Discuss any impact of any current or anticipated commitments which may impact the ability of the Offeror or its subcontractors to complete the Technical Assistance as proposed and within the project schedule.
2. Identify any specific information which is needed from the Grantee before commencing contract negotiations.

3.3 SECTION 3: ORGANIZATIONAL STRUCTURE, MANAGEMENT, AND KEY PERSONNEL

Describe the Offeror's proposed project organizational structure. Discuss how the project will be managed including the principal and key staff assignments for this Technical Assistance. Identify the Project Manager who will be the individual responsible for this project. The Project Manager must have the responsibility and authority to act on behalf of the Offeror in matters related to the proposed Technical Assistance.

Provide a listing of personnel (including subcontractors and consultants) to be engaged in the project, either U.S. or local with the following information for key staff: position in the project; pertinent experience, curriculum vitae; other relevant information. If subcontractors are to be used, the organizational relationship between the firms must be described.

A manpower schedule and the level of effort for the project period, by activities and tasks, as detailed under the Work Plan shall be submitted. A statement confirming the availability of the proposed project manager and key staff over the duration of the project must be included in the proposal.

3.4 SECTION 4: TECHNICAL APPROACH AND WORK PLAN

Describe in detail the proposed technical approach and work plan. Discuss the project requirements as perceived by the Offeror. Include a brief narrative of tasks within each activity series. Begin with the information gathering phase and continue through delivery and approval of all required reports.

Prepare a detailed schedule of performance that describes all activities and tasks within the Technical Work Plan, including periodic reporting or review points, incremental delivery dates, and other project milestones.

Based on the Technical Work Plan, and previous project experience, explain when and where Offeror will require support from the Grantee. Detail the amount of staff time required by the Grantee or participating agencies and any work space or facilities needed to complete the Technical Assistance.

3.5 SECTION 5: EXPERIENCE AND QUALIFICATIONS

Provide a discussion of the Offeror's experience and qualifications which are relevant to the objectives and TOR for the Technical Assistance. If a subcontractor(s) is being used, similar information must be provided for the prime and each subcontractor firm proposed for the project. Relevant experience and qualifications of key staff proposed shall be provided including letters of commitment from the individuals proposed concerning their availability for contract performance.

As many as possible but not more than six (6) relevant and verifiable project references must be provided, including the following information:

- Project name,
- Name and address of client (indicate if joint venture),
- Client contact person (name/ position/ current phone and fax numbers),
- Period of Contract,
- Description of services provided,
- Dollar amount of Contract, and
- Status and comments.

Offerors are strongly encouraged to include in their experience summary primarily those projects that are similar to or larger in scope than the Technical Assistance as described in this RFP.

Section 4: AWARD CRITERIA

Individual proposals will be initially evaluated by a Procurement Selection Committee of representatives from the Grantee. The Committee will then conduct a final evaluation and completion of ranking of qualified Offerors, and the Grantee shall promptly negotiate a contract with the best qualified Offeror. If a satisfactory contract cannot be negotiated with the best qualified Offeror, negotiations will be formally terminated. Negotiations shall then be undertaken with the second most qualified Offeror and so forth.

The selection of the Contractor will be based on the following criteria:

- 1. Experience of the Firm in Asset Integrity Management (AIM) of Petroleum Refineries:** This includes Process Plant Equipment & Pipelines.
20% (200 points)

In this criterion, the Grantee will only consider projects where the Offeror was involved as the prime contractor.

The maximum score will be awarded to that proposal that reports at least five (5) projects developed and implemented in the last ten (10) years. Those proposals with less than five (5) projects reported will be scored proportionally.

- 2. Experience of the Firm in Application of the Technologies and AIM Inspection Methodologies that are specified in the scope of work.**
40% (400 points)

These technologies and inspection methodologies include:

- Risk Based Inspection (50 Points)
- Risk Based Inspection Training (50 Points)
- Ultrasonic Testing of Storage Tanks (40 Points)
- Ultrasonic Testing of Pipelines (40 Points)
- Extreme Value Analysis (20 Points)
- Guided Wave Ultrasonic Testing (GWUT) (40 Points)
- Chirp UT Systems (20 Points)
- LIXI Profiler or equivalent (20 Points)
- Acoustic Emission Testing (50 Points)
- In-Service Robotics for Storage Tanks (40 Points)
- Corrosion Inspection and Monitoring (30 Points)

The maximum score will be awarded to that proposal that reports at least one project covering each of the respective technologies and methodologies cited above, and those proposals reporting less than the complete number of technologies/methodologies will be scored proportionally.

**3. Experience of the Proposed Experts
30% (300 points)**

The maximum score will be awarded to that proposal that provides the maximum experience of the members of the team work (calculated using the weights indicated in the following table for each one of the proposed experts). The other proposals will be scored proportionally. The maximum experience that will be considered for calculation of the score is the one indicated in the last column of the table below.

Team Member	Minimum Experience	Weight	Maximum Points	Maximum Experience
Project Manager	10 Years	20 %	60	25
Risk-Based Inspection Engineer (Must have supplemental certification in API 580, in addition to certification in at least one of the following: API 510, API 570, or API 653)	10 Years	20 %	60	25
API Inspectors (2) (Must have certification in API 510, and knowledge of API RP-572, API RP 576, and ASME Sections V, VIII and IX)	5 Years each	10% 10%	30 30	20 20
NACE (Corrosion) Technician (Must have NACE certification)	5 Years	10%	30	20
Tank Technician Inspector (Must have certification in API 653, and knowledge of API 575, API 650, API 651, API 652, API 2015, API 2207, and ASME Sections V and IX)	5 Years	10%	30	20
Acoustic Emission Technician (Must have certification in API 570 and API 653, and qualified using specific acoustic emission technology on storage tanks and piping)	5 Years, including two years with the specific technology to be utilized	10%	30	20
Guided Wave Ultrasonic Testing (GWUT) Technician (Must have certification in API 570 and API 580, and be qualified	5 Years, including two years with the	10%	30	20

using the specific guided wave ultrasonic technology on pipe).	specific technology to be utilized			
TOTAL Weight and Points		100%	300	

**4. Technical Approach and Workplan
10% (100 points)**

The Grantee will consider the reasonableness of the technical approach and workplan the proposer describes for the accomplishment of the terms of reference. Each bidder shall demonstrate understanding of all project tasks. The proposed Work Plan should be detailed, realistic and manageable.

Proposals which do not include all requested information may be considered non-responsive.

Price will not be a factor in contractor selection.

ANNEX 1

Mr. S. C. Mehta, General Manager-Technical, Mumbai Refinery, Hindustan Petroleum Corporation Ltd., B.D. Patil Marg, Mahul, Mumbai 400-074, India, Phone: 011-91-22-2554-3482, Fax: 011-91-22-2554-4584

B: India - HPCL Asset Integrity Management Technical Assistance

POC Evangela Kunene, USTDA, 1000 Wilson Boulevard, Suite 1600, Arlington, VA 22209-3901, Tel: (703) 875-4357, Fax: (703) 875-4009. HPCL Asset Integrity Management Project. The Grantee invites submission of qualifications and proposal data (collectively referred to as the "Proposal") from interested U.S. firms which are qualified on the basis of experience and capability to provide technical assistance for an Asset Integrity Management (AIM) project for its petroleum refineries and associated pipelines.

The Grantee, Hindustan Petroleum Corporation Limited (HPCL), is seeking to develop a comprehensive program of Asset Integrity Management (AIM) that it intends to apply at its refineries in India. This type of program involves world class standards of inspection and maintenance of refinery facilities and pipelines to ensure the uninterrupted, reliable and efficient operation. This program, which utilizes advanced technologies and methodologies, is vital to minimize the risks and vulnerabilities of large scale petroleum operations, protect the safety of the workforce and neighboring population, and to maximize energy security for India.

The AIM program will draw largely on the experience and advanced technologies developed in the United States in conformity with standards and best practices as developed by the American Petroleum Institute (API), the National Petroleum Refiners Association (NPRA), the Pipeline Research Council International (PRCI), and other organizations. This is a significant capacity building project that will serve as a template for potential implementation of the program throughout the Indian petroleum sector. It also will provide an opportunity for a number of advanced U.S. technologies to be demonstrated and is likely to result in significant U.S. inspection services, equipment, and technology exports to India's refining sector.

The intention of this work is to: (1) assess the prevailing inspection systems and techniques now undertaken by HPCL for asset integrity management; (2) recommend improvements with respect to systems and procedures; (3) recommend new inspection methodologies and technologies that will enhance the safety and the integrity of petroleum refining operations, and will better ensure the reliability of meeting its petroleum products supply obligations to the Indian market, and (4) demonstrate some of these advanced technologies.

HPCL is a major public sector company under India's Ministry of Petroleum and Natural Gas. It is a petroleum refining and oil products marketing company which also has equity in upstream petroleum ventures. It is a Fortune 500 company (ranks 378) and accounts for roughly ten percent of India's domestic petroleum refining capacity. The Government of India holds 51 percent equity, and the remainder is held by other companies, banks,

mutual funds, and foreign investors. In addition, the Grantee operates two major refineries producing a wide variety of petroleum fuels & specialties, one in Mumbai (west coast) of 5.5 MMTPA capacity and the other in Vishakapatnam (east coast) with a capacity of 7.5 MMTPA. The Grantee holds an equity stake of 16.95% in Mangalore Refinery & Petrochemicals Limited, a state-of-the-art refinery at Mangalore with a capacity of 9 MMTPA, and owns and operates the largest lube refinery in the country with a capacity of 335,000 metric tons and accounting for more than 40 percent of the country's total lube base oil production.

The Terms of Reference for this Technical Assistance will include:

- Task 1: Initial project meeting and site surveys
- Task 2: Training program
- Task 3a: Pilot risk based inspection implementation
- Task 3b: Advanced technology field demonstrations
- Task 4: Conduct technical evaluation
- Task 5: Preliminary environmental impact assessment
- Task 6: Development impact assessment
- Task 7: Prepare cost estimates and economic assessment
- Task 8: Provide list of equipment and technology suppliers
- Task 9: Training program recommendations
- Task 10: Deliverables and reporting

The U.S. firm selected will be paid in U.S. dollars from a \$628,926 grant to the Grantee from the U.S. Trade and Development Agency (USTDA).

A detailed Request for Proposals (RFP), which includes requirements for the Proposal, the Terms of Reference, and a background definitional mission report are available from USTDA, at 1000 Wilson Boulevard, Suite 1600, Arlington, VA 22209-3901. To request the RFP in PDF format, please go to:

<https://www.ustda.gov/USTDA/FedBizOpps/RFP/rfpform.asp>. Requests for a mailed hardcopy version of the RFP may also be faxed to the IRC, USTDA at 703-875-4009. In the fax, please include your firm's name, contact person, address, and telephone number. Some firms have found that RFP materials sent by U.S. mail do not reach them in time for preparation of an adequate response. Firms that want USTDA to use an overnight delivery service should include the name of the delivery service and your firm's account number in the request for the RFP. Firms that want to send a courier to USTDA to retrieve the RFP should allow one hour after faxing the request to USTDA before scheduling a pick-up. Please note that no telephone requests for the RFP will be honored. Please check your internal fax verification receipt. Because of the large number of RFP requests, USTDA cannot respond to requests for fax verification. Requests for RFPs received before 4:00 PM will be mailed the same day. Requests received after 4:00 PM will be mailed the following day. Please check with your courier and/or mail room before calling USTDA.

Only U.S. firms and individuals may bid on this USTDA financed activity. Interested firms, their subcontractors and employees of all participants must qualify under USTDA's

nationality requirements as of the due date for submission of qualifications and proposals and, if selected to carry out the USTDA-financed activity, must continue to meet such requirements throughout the duration of the USTDA-financed activity. All goods and services to be provided by the selected firm shall have their nationality, source and origin in the U.S. or host country. The U.S. firm may use subcontractors from the host country for up to 20 percent of the USTDA grant amount. Details of USTDA's nationality requirements and mandatory contract clauses are also included in the RFP.

Interested U.S. firms should submit their Proposal in English directly to the Grantee by 4:00PM, June 11, 2008 at the above address. Evaluation criteria for the Proposal are included in the RFP. Price will not be a factor in contractor selection, and therefore, cost proposals should NOT be submitted. The Grantee reserves the right to reject any and/or all Proposals. The Grantee also reserves the right to contract with the selected firm for subsequent work related to the project. The Grantee is not bound to pay for any costs associated with the preparation and submission of Proposals.

ANNEX 2

FINAL REPORT

Definitional Mission for the Oil and Natural Gas Sector in India

(Activity Number: USTDA-2007 21018A)

PART 3

Asset Integrity Management Technical Assistance for Petroleum Refineries

Proposed Grantee: Hindustan Petroleum Corporation Ltd.

January 2008

Submitted to:

UNITED STATES TRADE AND DEVELOPMENT AGENCY

By: MT ENERGY ASSOCIATES
8042 Merry Oaks Court
Vienna, Virginia 22182

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The U.S. Trade and Development Agency

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Asset Integrity Management Technical Assistance for Petroleum Refineries

A. Executive Summary.

Hindustan Petroleum Corporation Limited (HPCL) of India has requested USTDA funding for a technical assistance program on Asset Integrity Management (AIM) for its petroleum refineries and associated pipelines. HPCL is a large public sector company in India whose core business is the refining of crude oil and the marketing of petroleum products. HPCL operates two large refineries in Mumbai on the west coast and Visakhapatnam (Visakh) on the east coast with a combined refining capacity of 13 MMTPA (million tons per annum). This accounts for about ten percent of India's current refining capacity. HPCL also has equity interest in a refinery in Mangalore, and is currently developing a new refinery in Punjab. Plans call for the expansion of its refining capacity to 23 MMTPA.

The objectives of an Asset Integrity Management (AIM) system are the delivery of business requirements maximizing return on assets while maintaining stakeholder value and minimizing business risks associated with accidents and loss of production. Asset Integrity is the ability of an asset to perform its required function effectively and efficiently while safeguarding life and the environment. The related management activities ensure that the people, systems, processes and resources that deliver integrity, are in place, in use and fit for purpose over the whole lifecycle of the asset. HPCL and the other petroleum refining companies are more sensitized to the need to improve inspection services throughout the refinery, including process units (pressure vessels) storage tanks, and piping to avoid the consequences similar to that arising from the Texas City refinery disaster which has been attributed by U.S. regulators and independent studies to non-compliant lax practices and excessive cutbacks in investment for inspection and maintenance. The Oil Industry Safety Directorate (OISD) which is the safety regulatory body of India's Ministry of Petroleum and Natural Gas supports the refining industry augmenting safety practices and adopting new proven cost effective technologies.

The HPCL requirement to establish a comprehensive AIM program and acquire or utilize through contractor services advanced technologies for refinery inspection stems from the company's intent to keep pace and ahead of more stringent safety standards in accordance with evolving world class best practices. The adoption of new technologies and methodologies in safety inspection and refinery maintenance will: (1) enhance HPCL's capability to maintain reliable refinery throughput to meet growing domestic market requirements for petroleum products; (2) improve energy security by minimizing the risks of catastrophic outages to its infrastructure and operations which would seriously reduce oil

product supplies to its customers; (3) provide more cost effective solutions, and (4) develop the knowledge and skill sets of its workforce.

Much of the new equipment and technologies to improve implementation of an AIM program are available through U.S. oil industry equipment manufacturers and services companies. HPCL spends more than US\$60 million each year on repairs and maintenance. Inspection services and related costs for the HPCL refineries amount to several million dollars per year, and the inspection costs for the industry as a whole is an order of magnitude greater. The adoption of new approaches and technologies offers a potentially large export opportunity for U.S. suppliers of equipment and services.

HPCL presented USTDA with a list of 14 new areas of investigation for inspection technologies and methodologies, which all function consistent with the standards set in the United States under American Petroleum Institute (API) guidelines for refineries. This includes such practices as Risk Based Inspection (RBI) and Extreme Value Analysis (EVA), and the demonstration of advanced technologies such as guided wave ultrasonic testing (GWUT), acoustic emission testing (AET), real-time corrosion monitoring, and robotic inspection of storage tanks.

On the basis of those requirements, we formulated a comprehensive scope of work for a safety inspection technical assistance program that would cover each of the areas requested by HPCL through a combination of training courses, on-site technology demonstrations, and actual implementation of selected inspections at the Mumbai refinery. The training and technology demonstrations are intended to include a small number of participants from other refining companies in India, as well as OISD. This should allow for the broader review and application of state of the art inspection technology and practices across the domestic refining industry of India in a cost effective manner.

There is a high probability that some or all of these practices will be adopted by the Indian petroleum refining sector, and that U.S. firms will be highly competitive for supply of expert services, equipment and technology.

HPCL has reviewed and accepted the scope of work (see Section L below). The budget for this technical assistance was subsequently developed. The estimated cost is US\$610,926. The project is unique because it actually introduces not one but a broad range of technologies for refinery and pipeline inspection that may be supplied by U.S. manufacturers and/or services companies on a turnkey basis.

MT Energy Associates recommends that USTDA fund this technical assistance on its merits as a capacity building project, as well as for its U.S. export potential, for its benefits regarding the security of energy supply, and as a potential deliverable of the U.S. – India Energy Dialogue's Oil & Gas Working Group.

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B. Project Description.

Introduction

Hindustan Petroleum Corporation Limited (HPCL) is seeking to develop a comprehensive program of Asset Integrity Management (AIM) that it intends to apply at its refineries in India. This type of program involves world class standards of inspection and maintenance of refinery facilities and pipelines to ensure the uninterrupted, reliable and efficient operation. This program, which utilizes advanced technologies and methodologies, is vital to minimize the risks and vulnerabilities of large scale petroleum operations, protect the safety of the workforce and neighboring population, and to maximize energy security for India.

The Asset Integrity Management program will draw largely on the experience and advanced technologies developed in the United States in conformity with standards and best practices as developed by the American Petroleum Institute (API), the National Petroleum Refiners Association (NPRA), the Pipeline Research Council International (PRCI), and other organizations. This is a significant capacity building project that will serve as a template for potential implementation of the program throughout the Indian petroleum sector. It also will provide an opportunity for a number of advanced U.S. technologies to be demonstrated and is likely to result in significant U.S. inspection services, equipment, and technology exports to India's refining sector.

Hindustan Petroleum Corporation Ltd. (HPCL) Background

HPCL is a major public sector company under India's Ministry of Petroleum and Natural Gas. It is a petroleum refining and oil products marketing company which also has equity in upstream petroleum ventures. It is a Fortune 500 company (ranks 378) and accounts for roughly ten percent of India's domestic petroleum refining capacity. The Government of India holds 51 percent equity, and the remainder is held by other companies, banks, mutual funds, and foreign investors.

HPCL operates two major refineries producing a wide variety of petroleum fuels & specialties, one in Mumbai (west coast) of 5.5 MMTPA capacity and the other in Vishakapatnam (east coast) with a capacity of 7.5 MMTPA. HPCL holds an equity stake of 16.95% in Mangalore Refinery & Petrochemicals Limited, a state-of-the-art refinery at Mangalore with a capacity of 9 MMTPA. In addition, HPCL is planning to set up a refinery in the state of Punjab. HPCL also owns and operates the largest lube refinery in the country with a capacity of 335,000 metric tons and accounting for more than 40 percent of the country's total lube base oil production. The marketing network of the HPCL consists of zonal offices in the four largest cities and 85 regional offices facilitated by a supply & distribution infrastructure comprising terminals, aviation service stations, bottling plants, and inland relay depots & retail outlets. HPCL operates 7,634 retail outlets or 24

percent of the retail outlets in India. The company also operates three long-distance pipelines.

The company has a number of strategic initiatives that will involve refinery expansions and upgrades. This includes a refinery bottoms Upgradation program at Mumbai, and expanding the Visakh refinery from 7.5 MMTPA to 15 MMTPA by 2010, which will include product quality upgradation, freight optimization and expanding crude storage capacity. Overall, it plans to expand total refining capacity at Mumbai and Visakh from 13 MMTPA to 23 MMTPA. The planned refinery in Punjab will also result in a new import terminal at Mundra (in Gujarat) and a new 1,011 km crude oil pipeline from Mundra to the refinery, along with six new pump stations and new above ground crude oil and product storage tanks.

Asset Integrity Management (AIM) Program

Asset integrity management is a comprehensive strategy employed by the international petroleum industry to maintain the safety and integrity of petroleum facilities, including refineries and pipelines. The companies in the industry make considerable investments annually as part of their health, safety, and environmental (HSE) commitments. This involves a variety of inspection activities that employ established and proved methodologies and technologies. The requirements for asset integrity management are included in the codes and standards set up by the petroleum industry and employed by operators to some extent on a voluntary basis, but mostly through regulatory enforcement to which the companies must comply. API has adopted standards that are applied not only in the United States, but throughout the world. These include:

- API 510 Internal and external visual inspections of pressure vessels involved in industrial processing, power generation, and the petrochemical industry.
- API 570 External visual inspections of piping involved in industrial processing, power generation, and the petrochemical industry.
- API 653 Internal and external visual inspections of storage tanks involved in industrial processing, power generation, and the petrochemical industry.
- API 580 Risk Based Inspection (RBI).

Visual inspections to pressure vessels, above ground storage tanks, and pipelines today include new non-destructive technologies (NDT) which permit the inspector to assess equipment for deformities, defects, corrosion, and risk of failures. These new technologies which are the subject of this proposed technical assistance are both cost effective and more reliable, and minimize the operational downtime otherwise required for inspection of refinery and pipeline system components using older methodologies. This technical assistance would be the first time many of these technologies will be introduced to India. The proposed technical assistance would involve training and on-site

demonstrations, as well as introducing advanced methods and processes for conducting comprehensive inspection programs.

Asset integrity management has become a higher priority than in the past, in part because of recent serious incidents such as the Texas City refinery fire that claimed 15 lives and forced the temporary shutdown of operations at this major refinery in the United States. This was followed by major integrity failures along the pipeline gathering system that collects crude oil from wells in the Prudhoe Bay in Alaska (the largest oilfield in the United States) – forcing a curtailment in critical domestic oil production. The causes of those multiple incidents were attributed by regulators and independent investigations to cutbacks in investments in safety inspection programs. As a result, the industry has been taking a more vigilant response to needed investment for safety management.

India can ill afford to have a catastrophic incident at one of its major petroleum refineries because it is highly dependent on maintaining its domestic petroleum product supplies to support its economic growth and to maintain energy security in the face of increasing demand for petroleum products. HPCL is focused on upgrading and expanding its existing refining capacity and is compliant and improving its safety and environmental management programs. As part of this effort HPCL is interested in developing a comprehensive program for asset integrity management.

HPCL AIM Requirements

MT Energy Associates met in Houston with senior officials of HPCL in February 2007 at the USTDA funded Indian refinery sector business briefing to discuss the HPCL interest in comprehensive asset integrity management for refineries and pipelines. MT Energy Associates met in Mumbai with HPCL to discuss their requirements. HPCL subsequently forwarded to us separate lists of requirements for USTDA support, the first covering its Mumbai and Visakh refineries and the second list regarding its pipeline requirements. Those requirements lists form the basis for the scope of work we have developed in this project.

Refinery Inspection: HPCL identified 14 areas of work that it wanted to investigate in order to improve its refinery inspection program, particularly at the Mumbai refinery, with future application to the Visakh refinery. These topics are as follows:

1. Non-Destructive Technology (NDT) and procedures to assess the condition of insulated piping without the removal of insulation.
2. NDT / procedures for internal inspection of a 38 inch diameter jetty water line to assess the condition of the cement lining.

3. Real-Time On-Stream monitoring of critical pipelines and components carrying high sulphur crude or highly corrosive products using ultrasonic monitoring.
4. Inspecting the condition of insulated columns without removing the insulation.
5. Complete internal / external inspection of studded convection tubes and boiler tubes.
6. Comprehensive inspection of reformer tubes with the help of Multi Probe crawler / Laser technique.
7. Assessing the condition of underground lines having bends without excavating the lines.
8. In-situ and laboratory techniques for assessing remaining life of furnace tubes, reactor - regenerator refractory lining, equipment operating in creep zones, etc.
9. Reliable condition assessment of bottom plates and shell for above ground storage tanks including the application of new robotic inspection technologies.
10. Inspection of insulated tanks without the removal of insulation.
11. Integrity assessment of Residual Catalytic Cracking (RCC) structures.
12. Onstream inspection of tower internals for purposes of ascertaining tray dislodgement, etc.
13. Substitute (alternative materials) for cement lining in salt water and rubber lined pipes for improved corrosion protection.
14. Reliability assessment techniques for super duplex stainless steel tubes in coolers.

Long Distance Pipeline Inspection: HPCL is fairly confident that its long distance transmission pipelines already employ many of the new technologies and strategies used by the industry worldwide. According to HPCL, the integrity of its existing pipelines (the Mumbai-Pune-Solapur pipeline and the Visakh-Vijaywada-Secunderabad pipeline) are monitored and managed through Supervisory Control and Data Access (SCADA) systems. Leak detection systems also provide for identification of breaches in the pipeline system. A similar SCADA system has also been provided for in the Mundra-Delhi pipeline project now under construction.

For external corrosion protection, the pipelines are coated by CTE coating / 3 layer PE coating. Protection from external corrosion is further strengthened by providing cathodic protection (CP) by sacrificial anode during the construction phase and an *impressed current cathodic protection* (ICCP) system during operation of pipeline. Cathodic protection is monitored regularly and CP stray current studies are carried out, wherever required. For internal corrosion protection, corrosion inhibitors are injected in the pipeline.

For corrosion monitoring, an *intelligent pigging* (IP) survey is carried out to assess the pipeline thickness over the entire pipeline length prior to commissioning of the pipeline. Subsequently, IP surveys are carried out at regular intervals as per the Oil Industry Safety Directorate (OISD) requirements to ascertain loss of metal. In case of abnormal losses, corrective action is taken. Other surveys like *close interval potential survey*, DC voltage gradient (DCVG) survey, *pipeline current attenuation survey*, *pipeline depth of cover survey*, pipeline right of way (ROW) survey and *continuous soil resistivity survey* are being carried out regularly in order to assess the health of the pipeline.

On the basis of the above description by HPCL concerning its safety management practices for its long distance pipelines, we have not included long distance pipelines in the present technical assistance scope-of-work. The pipeline division of HPCL, however, will consider the possible application of some of the technologies to be presented for piping at the refineries to their long distance lines.

Proposed Technical Assistance Program

Based on the above requirements set forth by HPCL, MT Energy Associates has formulated a technical assistance program that is designed to introduce HPCL to modern safety inspection methodologies and technologies now applied increasingly by the world petroleum industry. This will include having expert U.S. contractors examine both the Mumbai and Visakh refineries, and then train HPCL personnel on a comprehensive strategy for evaluating risk to petroleum refineries and related facilities (risk based inspection), and on a wide range of advanced technologies available from the United States. A number of these technologies will be demonstrated at the Mumbai refinery. The training and field demonstrations will be open to select individuals from other Indian refining companies and also to the Oil Industry Safety Directorate (OISD) which is the safety regulatory body for refineries, pipelines, and storage facilities (as well as upstream petroleum production) under the Ministry of Petroleum and Natural Gas. OISD will consider the wider application of these methodologies and technologies throughout the domestic petroleum refining sector.

This proposed technical assistance program provides a unique opportunity for a number of U.S. manufacturers and petroleum services companies to have their

disparate equipment and technology reviewed in one program for future application by the entire refining industry in India.

Selected Technologies and Processes

The technical assistance program will include but not be limited to the following non-destructive technologies and processes.

Guided Wave Ultrasonic Testing (GWUT)

In recent years much research and development work has gone into the development of techniques for the rapid screening of pipe for corrosion/erosion. This work has resulted in systems such as Teletest[®] and Wavemaker[™]. These systems make use of low frequency guided waves to detect corrosion/erosion in pipework. In the Teletest[®] Multi-Mode system a tool comprising five rings of piezoelectric transducers is clamped around the pipe and ultrasound is sent in both directions along the pipe. Three of the rings excite longitudinal waves in the pipe and two excite torsional waves. Using this system, the wave mode can be optimized for any given pipe. Data from one particular direction of propagation is interpreted in a single test. The signal obtained measures the severity of the corrosion. The signals are displayed from three different wave modes, namely symmetrical, horizontal flexural and vertical flexural. The relative intensities and characteristics of these three signals are important in identifying different distributions of corrosion. The recent development of the Teletest Focus[®] system allow the transducers to be fired as a phased array and the ultrasound to be focused at a specific spot both along the pipe and around its circumference. These allow the circumferential extent and position of corrosion locating to be determined and improve the signal to noise ratio. Although propagation distances vary according to pipe geometry, contents, coating/insulation and general condition, it is not unusual that a range of up to 30m (100') in either direction from the transducer can be inspected. The technique is equally sensitive to internal and external corrosion, but cannot distinguish between them.

The principal advantage of this technique is that it provides 100 percent initial screening coverage, and only requires local access to the pipe surface (i.e. removal of a small amount of insulation) at those positions where the transducer array is to be attached. It is suitable for use on pipe diameters above 50mm (2.0") and on wall thicknesses up to 40mm (1.6").

GWUT allows for detection of both internal and external corrosion/erosion in thermally insulated, coated and buried pipework, corrosion under pipe supports and hidden welded joints, as well as irregularities in girth weld shape. This technology is used in petrochemical process pipework, oil and gas transmission lines, gas manifolds, offshore risers, jetty lines and power station boiler tubes.

Acoustic Emissions (AE) Testing

Acoustic Emission (AE) testing is a method for examining the behavior of materials deforming under stress. Acoustic Emission may be defined as a transient elastic wave generated by the rapid release of energy within a material. Materials "talk" when they are in trouble: with Acoustic Emission equipment you can "listen" to the sounds of cracks growing, fibers breaking and many other modes of active damage in the stressed material.

Small-scale damage is detectable long before failure, so AE can be used as a non-destructive technique to find defects during structural proof tests and plant operation. AE also offers unique capabilities for materials research and development in the laboratory. AE equipment is adaptable to many forms of production QC testing, including weld monitoring and leak detection.

Some typical applications of the Acoustic Emission principle in testing materials are as follows:

Behavior of materials: metals, ceramics, composites, rocks, concrete:

- Crack propagation
- Yielding
- Fatigue
- Corrosion, stress corrosion
- Creep
- Fiber fracture, delamination

Monitoring structures:

- Continuous monitoring (metallic structures, mines, etc.)
- Periodic testing (pressure vessels, pipelines, bridges, cables)
- Loose part detection
- Leak detection

Special applications:

- Petrochemical and chemical: storage tanks, reactor vessels, offshore platforms, drill pipe, pipelines, valves, hydro-treaters

Robotic Inspection of Storage Tanks

An above ground storage tank (AST) is vulnerable to four basic categories of corrosion. These are exterior or atmospheric corrosion, internal product corrosion, internal vapor space corrosion, and internal and/or external bottom corrosion. On any given tank, depending on the product and conditions under which it is stored, the environmental conditions and the tank support material; there can be one or more of these types of corrosion occurring at any given time.

- Exterior corrosion, whether general or localized at crevices, is very easy to detect with an external inspection.
- Internal product corrosion is due to a corrosive liquid phase of the stored product.
- Vapor space corrosion is caused by the vapor phase of the product. These types of corrosion, as well as that sometimes located at liquid/vapor interfaces, are difficult to fully identify with an external inspection, which is traditionally performed using a number of statistically averaged discrete measurement points.
- Bottom corrosion, which can be either or both internal or external, is the most difficult of all to map without a thorough internal inspection.

API Standard 653, "Tank Inspection, Repair, Alteration and Reconstruction", prescribes the basic rules by which an owner should establish inspection intervals and extent of inspection to ensure safe tank operation. Inspection intervals are generally a function of the expected corrosion rate for the governing tank component.

The traditional inspection of above ground crude oil and petroleum product storage tanks is an expensive and time consuming process that requires the operator to take the storage tank out of service for as much as a month, drain and clean the inside of the tank, and have inspectors physically enter the tank for inspection. The Idaho National Engineering and Environmental Laboratory (INEEL) of the U.S. Department of Energy more than a decade ago developed the first in-tank robotic tool for underground storage tanks. (This laboratory has since been merged with the Argonne National Laboratory into the Idaho National Laboratory.) The robotic technology was subsequently modified for above ground tanks because of the large potential market. Today, there are a small number of U.S. firms well qualified to conduct inspections of storage tank interiors with robotic devices.

In-Tank tank inspection services meet these challenges with patented, confined-space cleaning and navigation systems combined with the technological know-how to produce accurate tank corrosion assessments in a wide array of hazardous fluid environments. The robots contain sensors and cameras and can safely inspect interior tank roofs, walls, and floors for deformities, cracks, and leaks. The process typically takes about four days, with the tank remaining in full service. The inspection and resulting engineering report satisfy API 653 guidelines for visual inspection and provide more extensive ultrasonic testing and evaluation than available with the conventional out-of-service process. If repair work is required, it can be scheduled in the future to help minimize repair expenses and plant disruption.

"The in-service robotic inspection technique allows companies to assess the integrity of an oil storage tank without removing the tank from service. Since the tank will not have to be cleaned for personnel to enter, the amount of waste and fugitive emissions generated will be greatly reduced, and safety will be increased. The cost savings from this technology are significant.

Real-Time Corrosion Monitoring

A number of technologies have been developed for the real-time monitoring of corrosion in storage tanks, pipelines, and equipment. Real-time monitoring allows the field or SCADA operator to detect specific areas in which corrosion is present and to identify the extent of corrosion that may produce failures and leaks. This can be done on a far more efficient, timely and productive basis than manual visual checks.

The cost of cathodic protection (CP) is a significant factor in corrosion control. Remote real-time inspection technologies have been approved in the United States by state regulatory agencies as an acceptable method for meeting API standards requirements to control and monitor corrosion rates.

The automated monitoring of the primary tank floor provides a safety margin previously unattainable with manual corrosion checks, and at a fraction of the cost of retrofitting an expensive CP system.

A typical installation for a number of storage tanks would place a corrosion probe inside the hollow bottom of crude oil or petroleum product storage tanks. The rate of corrosion is determined by measuring the amount of metal lost over time (which increases in proportion to the electrical resistance in the probe). The data may be transmitted by satellite or other media automatically at a predetermined rate compliant with inspection requirements (e.g. once per week) and the comparative data can then be analyzed for possible remedial action.

The remote acquisition process relieves field personnel of the burden of obtaining required data, but the automation/programmable aspect of the system enables the operator to set the level of information needed. This provides for more accurate data analysis.

A real-time corrosion monitoring system has several benefits:

- Provides immediate, accurate and reliable information to warn of potentially dangerous or damaging corrosion situations.
- Provides an elevated level of assessment, control and protection via the capability to monitor potential corrosion daily if required, control that could never be achieved with manual weekly measurements.
- By continuously monitoring and reporting corrosion levels in each production or storage facility the system provides management with the

information needed to maximize the utilization of each asset. This ensures a positive impact on production rates.

Lixi Profiler

The Lixi Profiler is a pipe inspection tool which HPCL has requested to be evaluated as part of this technical assistance. The Profiler utilizes a Gadolinium-153 isotope, engineered detection technology and proprietary software to provide the nondestructive testing (NDT) community with a hand-held tool for pipe inspection. There is no requirement to remove and replace insulation, or to cut a test hole and clean and prep the pipe surface - the Profiler is used with the insulation in place. Gadolinium 153 is a relatively low energy source that does not risk exposure to radiation.

Risk Based Inspection (RBI):

Optimum performance in a process plant depends on maintaining a fine balance among many complex mechanical systems, while avoiding failure in key assets that could lead to unplanned shutdowns. Risk-based inspection (API-580) is a systematic, standard method for prioritizing inspection activities to focus first on "high-risk" assets. Risk is described in terms of both the likelihood of occurrence and the consequences of failure. The challenges to performing RBI effectively are:

- Knowing what to look at in a process plant
- Having a tailored methodology that is appropriate to the plant type and history and its equipment inventory
- Having access to a technically appropriate empirical basis for estimating the likelihoods of failure and the consequences of mechanical failures
- Having access to and understanding of "condition assessment" technology
- Managing a very large inspection, safety and chemical process database
- Being able to track changing conditions in a plant

Condition assessment is a synonym for "inspection": Physical inspection of tubes, piping and pressure vessels in process plants – using ultrasonics and laser profilometry, and magnetic field measurements, among other specialized NDT tools produces data that describe the condition of equipment and its components, and provide evidence of many types of macro- and micro-scale damage. These data are used in the fitness-for-service and damage evaluations described above, or are often used in simple visualizations that help to characterize the variability of operating parameters (e.g., temperature fluctuation and distribution in a fired process heater in a large or complex piece of equipment.

Condition Assessment also is a synonym for damage evaluation, life prediction and operating recommendations for equipment and units: It identifies what conditions caused the damage, what exactly the damage is,

through which mechanisms the damage developed, if the equipment or component has not yet failed, then what is the estimated remaining life considering a specific damage mechanism, and what are the operating recommendations that would prevent damage in the future or permit continued operation of the damaged equipment in the present.

Condition Assessment is a synonym for "Fitness-For-Service": Condition assessment can refer to an engineering evaluation of the physical condition of a piece of equipment or a component in which damage or a flaw has been detected. The focus of such an evaluation is to determine if the equipment can continue in service, and if so, for how long. For a number of types of equipment, industry standards such as API 579-1 specify a quantitative procedure for making a fitness-for-service determination, but for many other equipment or component types there are no such standards. In those cases, a semi-quantitative or qualitative approach, often including a remaining life prediction, may be used to reach a decision on whether the equipment should continue in service.

Extreme Value Analysis (EVA)

The critical information in condition assessment often is an estimate of the localized maximum extent of damage (e.g., pitting in pipe wall). NDT sampling data may include a large number of points, but do not necessarily contain the maximum or minimum values present in the asset. Physical processes (like corrosion), typically can be described by a large collection of random observations, and typically generate probability distributions of one of several characteristic shapes. All of these characteristic probability distributions have long ("fat") tails that can be analyzed to make reasonable estimates of their extreme values. For example, a set of NDT in-line corrosion inspection data can be analyzed to predict the maximum depth of pitting or the maximum density of pitting within the piping in question. This is called extreme value analysis (EVA).

C. Developmental Impact.

The proposed asset integrity management program for Hindustan Petroleum will have a highly positive impact on the economy of India, as well as on that country's energy security. The assistance will be in the form of expert technical services and training that will assist HPCL in enhancing its institutional capabilities to maintain the reliability of refinery and pipeline operations through adoption of world class inspection and maintenance strategies and technologies.

While the initial focus largely will be placed on meeting the specific requirements of HPCL, the introduction of asset integrity management will be felt throughout the refining sector of India. Both the Ministry of Petroleum and Natural Gas and the Oil Industry Safety Directorate (OISD) have indicated that this work – in which new advanced technologies will be introduced – could potentially be a template for application by other refining companies in India. HPCL accounts for only about 20 percent of the refinery throughput in the country, and the adoption of new standards through this project could lead to far larger utilization in India to achieve best practices.

Infrastructure: Technical assistance provided under a comprehensive asset integrity management program (protection of the refinery and pipeline assets) would greatly enhance the safety of operations for India's refineries and associated pipelines. This program will enable the refinery operators to better identify and mitigate the risks of unanticipated disruptions to service, and prevent potential catastrophic losses of major refinery units due to accidents. Recent experience in the United States (where safety standards and enforcement are high) at the Texas City refinery and at the pipeline gathering systems in Prudhoe Bay, Alaska demonstrate that the failure to conduct appropriate inspections and maintenance can lead to significant losses to critical infrastructure, product throughput, and revenue, as well as heighten the physical vulnerability of the work force. Given the current and projected petroleum product supply / demand imbalance in India, this exposure also poses a major energy security issue.

Market-Oriented Reform The successful implementation of the asset integrity management project for HPCL will provide an opportunity for the Oil Industry Safety Directorate (OISD) and the various operating companies in India to evaluate the need for improved cost effective standards and regulations regarding inspections and maintenance for refineries and pipelines, including the use of selected modern technologies, to increase reliability and integrity.

Human Capacity Building As these projects are applied by the refining industry, increasing numbers of personnel will be trained in the application of technologies not presently in use in India. They will be operating under standards and guidelines considered best practices for the industry worldwide. In addition, the skill sets to be developed will have a broader future impact on the economy in terms of human capacity building. U.S. manufacturers will license some of these technologies for local use in India which will likely lead to the expansion of the domestic petroleum services industry.

Technology Transfer and Productivity Improvement The implementation of asset integrity management projects in India will result in a substantial amount of technology transfer and higher productivity levels. For example, some of the new inspection technologies not previously available that will be presented in this project do not require the operator to shut down processing units and drain storage tanks. This will for the first time allow the plant units to continue in service with no temporary loss of throughput volume or added expenses as have been incurred previously when units are taken off-line.

Other As stated above, the HPCL asset integrity management project has a high probability of being replicated throughout the refining sector in India, and may be applied to the petrochemicals and other industries.

D. Project Sponsor's Commitment.

Hindustan Petroleum Corporation Limited (HPCL) is an Indian public sector company under the Ministry of Petroleum and Natural Gas. HPCL has been supportive of implementing a comprehensive "asset integrity management" program for their petroleum refineries and associated pipelines as part of its commitment to health, safety and the environment. HPCL invests several million dollars each year to sustain the integrity of its refinery operations through inspections, maintenance, and incorporation of new technologies that improve its ability to detect potential problems that pose risks to operation and the safety of workers.

MT Energy Associates had the opportunity to meet with the HPCL officials in Houston in early February 2007, during the USTDA sponsored India refinery sector orientation visit, to discuss asset integrity management. During the DM visit to Mumbai in late June 2007, we met with senior HPCL refinery officials at their headquarters to address asset integrity management at length. HPCL gave us a formal presentation regarding their views on asset integrity management. HPCL subsequently sent a detailed requirements document which forms the basis for the current scope of work we have prepared through iteration with HPCL. This scope of work includes the detailed evaluation and demonstration of advanced new inspection technologies from U.S. suppliers that have a higher degree of accuracy and are more cost efficient. The scope also includes essential training on procedures and technology application.

Mr. Arun Balakrishnan, Chairman and Managing Director of HPCL has indicated that this is a priority project intended to improve the long-term safety of the refinery assets and the integrity of operations. Mr. S.C. Mehta, HPCL General Manager of Operations has indicated that he would like to have the project fast tracked.

We had addressed this project in early July 2007 in New Delhi with Mr. Prabh Das, Joint Secretary of the Ministry of Petroleum and Natural Gas who is responsible within the Ministry for refining, pipelines and other downstream petroleum activities. Mr. Das indicated that the Ministry would support this effort if HPCL was interested in pursuing it. This is important because the Petroleum Ministry and the Department of Economic Affairs (Ministry of Finance) must approve USTDA grants to public companies in India's oil and gas sector.

In early August 2007, we showed the draft scope of work to Mr. J.B. Verma, Executive Director of India's Oil Industry Safety Directorate (OISD) during his visit to Washington, D.C., and he concurred in the importance of this project. It is possible that the project will lead to enhanced standards and practices throughout the refining sector.

E. Implementation Financing.

Hindustan Petroleum Corporation Limited is a financially profitable public sector undertaking under the Ministry of Petroleum and Natural Gas. The company achieved gross profit of more than US\$ 700 million and net profit of US\$ 359 million during the 2006-07 Indian fiscal year, from a sales volume exceeding US\$ 22 billion.

HPCL is a Fortune 500 company whose petroleum refining capacity has increased from 5.5 million tons in Indian fiscal year 1984/85 to 13.82 million tons at present. HPCL operates two major refineries producing a wide variety of petroleum fuels & specialties, one in Mumbai (west coast) of 5.5 MMTPA capacity and the other in Vishakapatnam (east coast) with a capacity of 7.5 MMTPA. HPCL holds an equity stake of 16.95% in Mangalore Refinery & Petrochemicals Limited, a state-of-the-art refinery at Mangalore with a capacity of 9 MMTPA. In addition, HPCL is planning to set up a refinery in the state of Punjab. HPCL also owns and operates the largest lube refinery in the country with a capacity of 335,000 metric tons and accounting for more than 40 percent of the country's total lube base oil production. The marketing network of the HPCL consists of zonal offices in the four largest cities and 85 regional offices facilitated by a supply & distribution infrastructure comprising terminals, aviation service stations, bottling plants, and inland relay depots & retail outlets.

HPCL is able to fund its refinery and pipeline inspection and maintenance programs from its operating budget. It also has the ability to raise capital from borrowing for various major ventures (e.g. refinery expansion or upgradation programs), but it is unlikely to require to do so for an asset integrity management program.

HPCL maintains a staff to implement safety and environmental management programs, but it most often applies new technologies in this area through turnkey contracts utilizing outside services providers having the requisite technologies. U.S. manufacturers and service companies in the field of safety and environmental management may opt to approach selected agencies for financing and financial guarantees. This may include the Multilateral Investment Guarantee Agency (MIGA) and the Overseas Private Investment Corporation (OPIC) both of which provide political risk insurance for U.S. exporters involved in international transactions. OPIC insurance is available for investments in new ventures or expansions of existing enterprises and can cover assigned inventory and equipment, exporters' or contractors' exposures, and advanced payments and guarantees posted in favor of foreign buyers. MIGA programs are designed to encourage foreign investment by filling gaps in investment insurance against non-commercial risks in developing countries.

	2006-07	2005-07	2005-06	2004-05	2003-04	2002-03
Financial Performance	US\$ Million					Rs./ Crores
Sales / Income from operations	22,143	96,918.15	76,920.26	65,218.33	57,511.13	54,259.48
Gross Profit	707	3,094.14	1,151.21	2,381.83	3,642.66	3,139.06
Depreciation	161	704.00	690.23	659.59	606.58	574.25
Interest	97	422.98	175.88	81.64	55.65	153.02
Tax (Incl. Def Tax)	88	386.15	(131.91)	363.27	1,076.49	874.43
Provision for Fringe Benefit tax	2	9.84	11.38			
Net Profit	359	1,571.17	405.63	1,277.33	1,903.94	1,537.36
Dividend	140	610.80	101.80	509.00	748.81	678.66
Tax on Distributed Profits	22	97.75	14.28	71.15	95.65	78.26
Retained Earnings	197	862.62	289.55	697.18	1,061.48	780.44
Internal Resources Generated	366	1,603.08	989.47	1,277.44	1,722.10	1,375.76
Value Added	1,419	6,209.19	4,198.13	5,208.06	6,061.19	5,115.14
Net Worth	2,193	9,598.65	8,735.74	8,440.85	7,742.81	6,678.85
Share Capital	77	338.95	338.94	338.93	338.90	338.83
Reserves	2,116	9,259.70	8,396.80	8,101.92	7,403.91	6,340.02
Physical Performance (In MMT)						
Crude Thruput		16.66	13.82	13.94	13.70	12.93
- Mumbai Refinery		7.42	6.25	6.12	6.11	6.08
- Visakh Refinery		9.24	7.57	7.82	7.59	6.85
Market Sales		21.69	19.42	20.09	19.53	18.84

While new refinery construction projects offer major opportunities for US export potential the maintenance requirements to assure the reliability of throughput is a large annual operating cost. It is estimated that world class refiners will spend on average US \$0.50 to \$1.00 per barrel of processed crude to inspect their assets and that roughly US \$1.50 to \$3.00 per barrel of processed crude oil is required to maintain these assets. The inspection processes include not only non-destructive technologies (NDT), but also environmental and security analysis. The NDT portion of these inspection costs typically is approximately 30% to 40%. For a refining capacity equivalent to that of India, annual NDT inspection services on a world class basis would amount to between US\$175 million and US\$300 million across the industry. On the assumption that India does not incur the level of inspection costs suggested by U.S. and European refiners, and that only a portion of these costs will be imported services and technology, we estimate that the annual import costs for inspection alone will approximate \$80 million. In many cases, U.S. and other foreign technologies have been purchased or leased by Indian services companies that carry out this work. The financial reporting information available from Indian refining companies is aggregated and therefore insufficient to determine a precise level of spending and imports for refinery inspections alone.

The use of robotics for remote inspection of above ground storage tanks is one example of how the employment of new technology will promote cost savings for HPCL and increase the U.S. export potential. The periodic internal inspection of storage tanks is a regulatory standard worldwide. Prior to the development of robotics, storage tanks had to be taken out of service, drained of all liquid and gas, cleaned, and then visually examined by an inspector for potential corrosion, cracks and other damage to roofs, walls and floors. This process could keep a tank out of service for about a month incurring high indirect costs for the inspection. An example of a comparative cost breakdown between taking a storage tank out of service vs. using robotics is shown in the following table. In this example, the cost to the operator **for inspection of a single tank** by the latter procedure is cut by 70 percent, while the use of an imported robotic inspection tool **adds US\$33,500 to the export potential**. In addition to the thousands of above ground storage tanks at refineries throughout India, there are cumulatively a large number of storage tanks at crude oil terminals and at marketing centers downstream of refineries, all of which require similar inspection services. Inspection guidelines typically require visual inspection (which includes remote robotic inspection) on a ten year cycle for each above ground tank, with shorter inspection periods for those units having known problems. Robotic tank inspection alone offers a significant business and export opportunities for U.S. manufacturers and services companies.

Other technologies that will be addressed in this technical assistance such as guided wave ultrasonic testing, acoustic emission testing, corrosion testing, etc. that will be applied to pipelines and process units at the refineries present substantial additional U.S. export potential. Few U.S. companies offer the full

range of inspection services, technology, and RBI training identified in this technical assistance; however, cumulatively U.S. firms are capable of supplying all of the services.

Figure 2: Cost Comparison of Out-of-Service vs. Robotic Inspection Methods

	Out of Service	Robotic
Direct Costs:		
Tank Cleaning (estimated):	\$10,000	\$0
Tank Inspection (estimated):	\$ 5,000	\$33,500
Waste Processing		
11¢/gal x 45,000 gallons	\$ 4,950	\$0
Transportation	\$ 6,750	\$0
Total Direct Costs:	\$26,700	\$33,500
Indirect Costs:		
Planning and Administration	\$ 5,000	\$500
Saleable gasoline sent to reclamation company		
\$0.75/gal x 35,000 gallons:	\$26,250	\$0
Product Differential (1)		
Storage & Handling (600,000 x 2¢/gal):	\$12,000	\$0
Small Lot (600,000 x est. 2¢/gal):	\$12,000	\$0
Truck Loading and Admin (2)		
120 loads at est. \$50/load	\$ 6,000	\$0
Premature Repairs	\$ 25,000	\$0
Total Indirect Costs:	\$ 86,250	\$0
Total Costs:	\$112,950	\$ 34,000

Hindustan Petroleum Corporation

According to the HPCL financials, the company spent 241.23 crore rupees (approximately US\$60.3 million) on repairs and maintenance to plant and machinery during fiscal year 2006-07. We estimate that inspection services totaled about US\$20 million in this period, although there is no specific line item for inspection, with NDT probably accounting for roughly US\$6 million to US\$7 million.

HPCL, which accounts for about ten percent of India's petroleum refining capacity, has approximately 150 above ground storage tanks of varying sizes at its Mumbai refinery, and a roughly equivalent number at its Visakh refinery. Assuming that robotic tank inspection will typically be conducted on a ten-year cycle, the annual foreign exchange expenditures by HPCL on this technology alone would be approximately US\$1 million per year. If adopted as a standard practice for India's petroleum refining industry, the annual foreign exchange expenditures for this technology would amount to about US\$10 million.

US manufacturers and services companies are highly competitive for the supply of robotics and other advanced high technology inspection equipment and services, and they are likely to obtain the majority of overall procurement in these specialized areas.

Following the inspections, HPCL will likely take remedial measures to implement the findings of the inspections as part of their maintenance programs. The resulting annual expenditures on improved refinery maintenance, retrofits and upgrades (for the two HPCL refineries) are likely to be on the order of \$20 million or more, of which US firms would be very competitive.

The Oil Industry Safety Directorate (OISD) has indicated that, based on the results of this technical assistance project, it would consider modifying standards and regulations regarding inspections to have refiners apply these new methodologies (e.g. RBI) and technologies to the other refineries throughout India. This would increase the potential for U.S. exports by an order of magnitude.

Forms of US Exports

AIM technology acquisition from the United States by Indian companies may take one of several forms. These choices will influence the cumulative value of US export content.

- Direct equipment and technology acquisition by the local refining companies based on technical specifications and through an international competitive bid process. The technical selection is likely to be based on performance and capital and operating costs, as well as approval of particular inspection techniques by the regulatory authority (in this case the Oil Industry Safety Directorate). Procurement in this case will be from the manufacturers that supply the technology to the industry. Most manufacturers do not supply on-site inspection services
- Procurement of turnkey inspection services from US contractors. These contractors provide one or a range of inspection services. A limited number of these contractors operate internationally and have a complete range of the most advanced technologies.
- Partnerships and joint ventures between US services companies and technology suppliers with Indian engineering and services companies in order to implement the safety inspection technology at more competitive labor costs. These JVs might include a large public sector company such as Engineers India Limited (EIL) or small private sector companies such as Industrial Inspection Services (Mumbai).
- Training services in advanced technologies and methodologies for conducting safety inspections and asset integrity management programs.

US Suppliers

There are hundreds of US companies that provide refinery inspection technologies and services. This ranges from subsidiaries of large US conglomerates to small specialized companies. Many of these are members of non-profit industry associations such as the American Society for Non-Destructive Testing (ASNT) and NACE International (corrosion control). Only some US companies have the capability for potential work outside North America. Decisions on whether they would choose to compete for sales and work in India will be governed by several factors including: the specifications, terms and conditions of RFPs that would be issued by HPCL and other Indian refining companies; assumptions of price competitiveness; the ability to mobilize staff and equipment, and the backlog of other contracted work.

A small representative listing of these companies is as follows. (The list is not intended as a USTDA endorsement of technology and services from these companies to the exclusion of non-listed companies):

Technology Manufacturers:

- TWI North America, Inc.
- Metroplex-Core (Houston, TX)
- General Electric
- Petromax Technologies
- Berkeley Springs Instruments LLC (WV)
- Lixi Inc.
- Lightning Eliminators & Consultants Inc. (Boulder, CO)
- Solex Environmental Systems (Houston, TX)

Inspection Services Companies

- TechCorr USA LLC (Houston, TX)
- Conam Inspection and Engineering Services, Inc. (Princeton Junction, NJ)
- UOP - a Honeywell Company (Des Plaines, IL)
- CRS Refinery Services, (Houston, TX)
- Cascade Refinery Services (Ferndale, WA)
- Owensby and Critikos, Inc. (Gretna, LA)
- HD Laboratories (Issaquah, WA)
- Quality Material Inspection, Inc. (Huntington Beach, CA)
- Petrochem Inspection Houston, TX)
- Praxair Inc. (Danbury, CT)
- Mechanical Integrity (Houston)
- Pro-Inspect (Houston)

AIM Training Services and Technical Reports

- Technical Toolboxes (cooperative partnerships with GTI and PRCI)
- Petroskills (Houston)

G. Foreign Competition.

A number of non-US companies are competitive in the supply of inspection equipment and services for refineries and pipelines across the spectrum of technologies applied to process units, storage tanks, and pipelines. Risk Based Inspection (RBI) and its variants are performed by services companies from a number of countries.

Among the well known non-US competitors is the long-established Det Norske Veritas (Norway) which conducts plant safety analysis at times supported by Norwegian government assisted programs. DNV offers a range of services to refineries ranging from SHE management assistance and damage investigation to asset operation services. The projects range from specific problem areas like noise and vibrations to environmental audits and risk analyses, and emergency preparedness analyses, including terminal ship operations.

TWI of the United Kingdom is involved in ultrasonic testing (A-Scan thickness surveys, A-Scan weld inspection, pulse-echo imaging, time of flight diffraction, phased array, surface ultrasonics, and long-range guided ultrasonics). TWI also conducts Engineering Critical Assessments (ECA) which utilizes a range of techniques (e.g. BS7910, API579) that can cover structures (e.g. pipelines, pressure vessels, etc.) and damage/failure mechanisms (fracture, fatigue, corrosion).

Tischuk of the United Kingdom offers risk based inspection training, technology and services that are in direct competition with U.S. firms. Its products also have been disseminated to partners in several countries including Indonesia, Korea, and Germany (as well as U.S. companies).

TUV NORD Group of Germany is a non-profit association that has a subsidiary (TUV India Pvt. Ltd.) located in Mumbai. TUV NORD Group is one of Germany's largest technical service organizations and provides inspection services, including technical safety, environmental protection, and conformity assessment of management systems and products.

Other companies offering services include: Roplast ROSEN (Switzerland); Cosmo Engineering Company Ltd. (Japan); AF Group (Sweden); Advantica (United Kingdom); Physical Acoustics Corporation (Malaysia) which designs and manufactures acoustic emission sensors and instruments; Korea Non-Destructive Testing and Internet Co., Ltd. (South Korea); Pi Energy. Emissions Ltd. (Aberdeen, Scotland), JMD International (Glasgow, Scotland), Bureau Veritas Group (Belgium), and European Technology Development Ltd. (United Kingdom).

The guided wave ultrasonic testing (GWUT) technology most prevalently used in the industry is generally Teletest[®] or Wavemaker[™], both of which are of UK origin, although the technology is widely utilized by U.S. firms for pipeline inspection. Typically, this technology would not be sold to refineries in India, but would be used by the service contractors that carry out the inspections on behalf of the operators. The cost effectiveness of Teletest is shown in the following table which compares a ratio of inspection costs (on 12-inch pipe) for this GWUT technology vs. other methodologies for conducting pipe inspection.

	No access problem	Insulated	Buried	Buried in road crossing	Buried and insulated	Elevated	Elevated and insulated
Visual	0.5	4.7	7.8	13.0	10.3	1.8	5.2
Manual UT	0.9	5.1	8.2	13.1	10.6	22	5.5
Mechanised UT	7.2	11.4	13	17.9	15.1	7.9	10.7
Profile Radiography	4.7	4.7	11.1	16.0	10.3	5.6	5.2
Pulsed Eddy Current	5.5	5.5	11.7	16.4	10.9	6.4	5.8
MFL	5.5	10.2	12.1	16.6	13.9	6.4	9.3
<i>Teletest[®]</i>	1	1	1	1	1	1	1

H. Impact on the Environment.

The proposed technical assistance for HPCL and the ensuing full implementation of an Asset Integrity Management (AIM) program will have a positive impact on the environment. The work is intended to improve the capability of petroleum refinery and pipeline operators to optimize the safety, operational reliability and integrity of their surface facilities through improved inspection and maintenance practices and by utilizing advanced technologies. This includes large process units, piping and storage facilities.

By minimizing the risk of accidents such as toxic leaks of liquids and vapor emissions, fires, explosions and other unanticipated events that cause service disruptions, proper comprehensive Asset Integrity Management mitigates the risks of contamination to soil, subsurface aquifers, water runoff, and releases of toxic chemicals into the atmosphere.

This is particularly significant from a health, safety and environmental (HSE) standpoint because the petroleum refining facilities to which these AIM processes will be applied are proximate to large urban populations. Therefore, the risk is not only to worker safety but also to the larger community.

Asset Integrity Management is endorsed by a number of major organizations in the United States including the American Petroleum Institute (API), the National Petroleum Refiners Association (NPRRA), and the Pipeline Research Council International (PRCI), all of which represent major segments of the petroleum industry. The United States has experienced a number of accidents at domestic refineries, most notably in 2005 at the BP Texas City refinery which resulted in the death of 15 workers and injury to 180 others. That accident caused a careful re-examination of both safety practices by operators, and criticism of federal inspection by government officials. The result has been a tightening of requirements for inspection and maintenance.

In the United States, OSHA is responsible for refinery inspections which are governed under the Process Safety Management (PSM) standards of the Clean Air Act. These standards require covered facilities such as refineries to implement 14 management elements to prevent catastrophic releases of hazardous substances. API also has a set of standards, but implementation of these by operators is voluntary. Subsequent to the Texas City accident, the U.S. Chemical Safety Board found more than 300 "egregious and willful violations" at the refinery and OSHA levied more than \$21 million in fines against BP.

Concerns in India for maintaining the integrity of refinery and pipeline operations are increasing. The petroleum refining sector in India (including HPCL) has been continually seeking to improve safety practices by the adoption of world class standards and the application of proven advanced technologies to prevent

catastrophic incidents. In addition, the government's Oil Industry Safety Directorate (OISD), which is the HSE regulator, is focused on minimizing risks to health, safety and environment. OISD has expressed an interest in this proposed technical assistance, and will consider its wider application to the entire refinery sector in India. For that purpose, OISD officials may participate in some of the training and field demonstrations of U.S. technology to be undertaken at HPCL in Mumbai.

The proposed technical assistance essentially will introduce HPCL to non-destructive inspection technologies application of which will pose little or no risk to the environment. On balance, this work will have a highly positive effect on the environment in terms of risk reduction.

I. Impact on U.S. Labor.

The Definitional Mission has reviewed the "Impact on U.S. Labor Statement" as contained in the Foreign Operations, Export Financing and Related Programs Appropriations legislation. That Statement details certain prohibitions on U.S. foreign assistance in cases in which the project to be funded, or the subsequent foreign country operation after the project is completed, would have a negative impact on U.S. labor.

Having examined the requirements of the U.S. legislation, the Definitional Mission finds that this project **does not** violate the provisions of the appropriations legislation.

The Hindustan Petroleum Corporation Ltd. Asset Integrity Management technical assistance is a capacity building project that will encourage and accelerate the utilization of U.S. based technologies in inspection and maintenance services at refineries in India. This will provide opportunity for future sales of equipment and supplies from the United States to implement the various inspection projects. This will create jobs for U.S. citizens in the course of project implementation.

The project provides a future opportunity for U.S. equipment and technology providers to expand their respective areas of business in India. However, it **does not** offer any financial incentive to a U.S. business enterprise currently located in the United States for the purpose of inducing that enterprise to relocate outside the United States with the effect of reducing the number of employees of such business enterprise in the United States because U.S. production is being replaced by such enterprise outside the United States.

The project **does not** assist in establishing or developing any export processing zone or designated area in which the tax, tariff, labor, environment, and safety laws of India do not apply, in part or in whole, to activities carried out within that zone or area.

The project **does not** provide assistance that contributes to the violation of internationally recognized workers rights.

The project **does not** provide direct assistance for establishing or expanding production of any commodity for export from India that is likely to be in surplus on world markets at the time the project becomes operative. The essence of the project is technical assistance and capacity building that will improve the capabilities of India's petroleum refining sector and government regulators to assess the risks to petroleum infrastructure and worker safety, and to more effectively monitor and set rules for refining and pipeline inspection and maintenance. The project will not cause substantial injury to US producers of the

same, similar, or competing commodity. The project will provide a market for U.S. commodities that heretofore was not available.

Development of asset integrity management projects resulting from the technical assistance will not lead to an export of existing U.S. labor overseas, but instead will add jobs to the U.S. economy. It will increase the opportunities for US labor and exports for various U.S. equipment, technology and services providers.

J. Qualifications.

The U.S. Company

The U.S. firm that is selected as the contractor to perform the asset integrity management technical assistance and field demonstrations and training should be qualified in each of the technical areas specified within the scope-of-work. These qualifications also can be met with the inclusion of experienced U.S. subcontractors. The U.S. firm also should be capable of independently utilizing and evaluating competitive technologies as called for in the scope-of-work. The U.S. Contractor should have carried out work previously in the following areas and should identify the specific projects, clients and dates for which this work has been carried out:

- Risk Based Inspection (RBI) of petroleum refineries
- Risk Based Inspection (RBI) Training
- Non-Destructive Technology (NDT) testing at petroleum refineries
- Real-time on-stream monitoring of crude oil and/or petroleum product pipelines using ultrasonic monitoring, and inspection of underground pipelines without excavation or removing insulation
- Inspection of above ground storage tank bottom plates, walls, and roofs utilizing robotic technology
- Integrity assessment of RCC structures
- Acoustic Emission (AE) Testing
- Guided Wave Ultrasonic Testing (GWUT)
- Training courses in the above technology areas

A minimum of five (5) previous projects should be presented.

The Technical Assistance Team

The individual team members should have the following qualifications in their respective areas of specialization:

1. Project Manager

The Project Manager will supervise the implementation various tasks under this technical assistance, including training and will have principal responsibility for the preparation of the required reports. This individual should have strong leadership skills, strong written and oral communication skills and strong organizational skills. This individual should be a professional engineer with a minimum academic achievement of a Bachelor of Science, and at least ten (10) years experience in the area of petroleum infrastructure.

The project Manager requires strong knowledge and experience with regard to:

- Inspection codes, standards, specification, and methods within the assigned area
- Inspection safety and incident prevention
- Process equipment and construction methods
- PM and identifying factors affecting reliability
- Maintenance/construction methods, terminology and best practices
- New technology applications
- Conducting training courses
- Analytical skills.

The Project Manager will be the principal interface with the designated officials of Hindustan Petroleum Corporation regarding assignments of the project team in implementing specific tasks and subtasks.

2. Risk Based Inspection (RBI) Engineer (API 580)

The RBI Engineer will be the lead consultant on Training (Task 2), RBI Implementations (Task 3A), and Field Technology Demonstrations (Task 3B). The RBI Engineer also will play a lead role in various other technical and economic evaluations and assessments.

The RBI Engineer must have supplemental certification in API 580 for risk based assessments, which is available from the American Petroleum Institute (API) for individuals that already are previously have received at least one other certification in API 510, API 570, or API 653 (discussed below).

Skill Requirements:

The RBI Engineer should meet the following criteria:

- A minimum of ten (10) years experience as a professional engineer
- A minimum academic achievement of a Bachelor of Sciences
- A minimum of two (2) years experience in work involving API 580 (risk based inspection)
- Previous experience in conducting training courses on subjects that will be covered in Task 2 of this technical assistance
- Knowledge of the advanced technologies that will be addressed in Task 3A and Task 3B.

3. API Inspector (API 510 Inspector)

Typical Function: API 510 Inspector will perform internal and external visual inspections of pressure vessels involved in industrial processing, power generation, and the petrochemical industry. Inspectors are required to be certified to API 510 and have field experience and inspection code knowledge of inspection in order to perform the following:

- Evaluate the condition of vessels, drums, towers, and exchangers for acceptability for continued service during turnarounds, capital projects and vessel repair shops in accordance with API 510, API RP-572, API RP-576, ASME Sections V, VIII and IX and client specifications.
- Determine the required repair procedures in accordance with code and industry standards.
- Evaluate NDE results (i.e., UT thickness data, WFMPT, ET) and make necessary recommendations concerning the remaining life of the equipment.
- Recommend new approaches and procedures to effect continual improvements in efficiency of the inspection and services performed.

Skill Requirements:

API-510 certification required

Strong written and oral communication skills

Strong organizational skills

Strong knowledge and experience with:

- Inspection codes, standards, specification, and methods within the assigned area
- Inspection safety and incident prevention
- Process equipment and construction methods
- PM and identifying factors affecting reliability
- Maintenance/construction methods, terminology and best practices
- Analytical skills

4. API Inspector (API 570 Inspector)

Typical function: API 570 Inspector will perform external visual inspections of piping involved in industrial processing, power generation, and the petrochemical industry. Inspectors are required to be certified to API 570 and have field experience and knowledge of inspection code in order to perform the following:

- The inspector will evaluate the condition of piping for acceptability for continued service during turnarounds, capital projects, and fabrication shops in accordance with API 570, API 574, ASME Sections V, and IX, B16.5, and B31.3, and client specifications.
- Determine the required repair procedures in accordance with code and industry standards.
- Evaluate NDE results (i.e., UT thickness data, WFMPT, ET) and make necessary recommendations concerning the remaining life of the equipment.
- Recommend new approaches and procedures to effect continual improvements in efficiency of the inspection and services performed.

Skill Requirements:

API-570 certification required

Strong written and oral communication skills

Strong organizational skills

Strong knowledge and experience with:

- Inspection codes, standards, specification, and methods within the assigned area
- Inspection safety and incident prevention
- Process equipment and construction methods
- PM and identifying factors affecting reliability
- Maintenance/construction methods, terminology and best practices
- Analytical skills

5. NACE (corrosion control) Technician

Typical Function: NACE Inspector performs internal and external visual inspections of coatings and linings involved in industrial processing, power generation, and the Petrochemical industry. NACE Inspectors are required to be certified and have field experience and knowledge of inspection code in order to perform the following:

- Evaluate the coating and lining condition of vessels, drums, towers, and exchangers for acceptability for continued service in accordance with NACE and client specifications.
- Determine the required repair procedures are in accordance with code and industry standards.
- Ensure timely and proper documentation of inspection findings and recommendations of repairs critical to plant safety.
- Evaluate NDE results (i.e., UT thickness data, WFMP, ET) and make necessary recommendations concerning the remaining life of the equipment.
- Recommend new approaches and procedures to effect continual improvements in efficiency of the inspection and services performed.

Skill Requirements:

NACE certification required

Strong written and oral communication skills

Strong organizational skills

Strong knowledge and experience with:

- Inspection codes, standards, specification, and methods within the assigned area
- Inspection safety and incident prevention
- Process equipment and construction methods
- PM and identifying factors affecting reliability

- Maintenance/construction methods, terminology and best practices
- Analytical skills

6. Tank Technician (API 653) Inspector

Typical Function: API 653 Inspector will perform internal and external visual inspections of storage tanks involved in industrial processing, power generation, and the petrochemical industry. Inspectors are required to be certified to API 653 and have field experience and knowledge of inspection code in order to perform the following:

Evaluate the condition of storage tanks for acceptability for continued service during turnarounds, capital projects in accordance with API 575, API 650, API 651, API 652, API 653, API 2015, API 2207, ASME Sections V, and IX, and client specifications.

- Determine the required repair procedures are in accordance with code and industry standards.
- Ensure timely and proper documentation of inspection findings and recommendations of repairs critical to plant safety.
- Evaluate NDE results (i.e., UT thickness data, WFMPT, ET) and make necessary recommendations concerning the remaining life of the equipment.
- Recommend new approaches and procedures to effect continual improvements in efficiency of the inspection and services performed.

Skill Requirements:

API-653 certification required

Strong knowledge and experience with:

- Inspection codes, standards, specification, and methods within the assigned area
- Inspection safety and incident prevention
- Process equipment and construction methods
- PM and identifying factors affecting reliability
- Maintenance/construction methods, terminology and best practices.

7. Acoustic Emission (AE) Technician

Typical Function: AE Technician will utilize acoustic emission testing technology to determine defects and deformity in materials.

Skill Requirements

- API 570 and API 653 certification required as explained above
- Operator should be qualified in using the specific acoustic emissions technology on petroleum storage tanks and piping and should have a minimum of two years field experience with the specific selected technology.

8. Guided Wave Ultrasonic Testing (GWUT) Technician

Typical function: GWUT Technician will utilize guided wave ultrasonic testing technology to detect both internal and external corrosion/erosion in thermally insulated, coated and buried pipework, corrosion under pipe supports and hidden welded joints, and irregularities in girth weld shape.

Skill Requirements

- API 570 and API 580 certification as explained above.
- Operator should be qualified in using the specific guided wave equipment (e.g. Teletest[®], Wavemaker[™] or other technology) on pipe and should have a minimum of two years field experience with the specific selected technology.

K. Justification.

The asset integrity management project for Hindustan Petroleum is a capacity building project for a large refining company in India, and also will serve as a template for similar application by the other refining companies in India. Bharat Petroleum, another public sector company has separately requested USTDA support for similar work tailored to their needs. In addition, the Oil Industry Safety Directorate (OISD) which is the safety regulatory body under the Ministry of Petroleum and Natural Gas responsible for refineries and pipelines has expressed an interest in possibly incorporating the risk assessment techniques and technology applications derived from this project into its rules for maintenance and inspection on an industry-wide basis.

An asset integrity management technical assistance for Hindustan Petroleum would provide the following:

- **Capacity building:** The project enhances infrastructure protection by minimizing the risk to critical petroleum facilities and provides energy security by better assuring the uninterrupted flow of petroleum products to domestic markets. The project addresses best practices that can be applied by both petroleum industry operators and government regulators, and offers training and skills development that will improve the competence of the work force.
- **HSE:** The project supports health, safety and environmental management practices at a world-class level.
- **U.S. technology demonstration:** The project provides a unique opportunity for several U.S. manufacturers and technology providers to have their technology solutions field demonstrated by the selected U.S. Contractor at facilities of potential foreign clients. Individually, it is unlikely that they would be able to incur the expenses of this marketing activity. From the USTDA perspective, it is a cost effective means of introducing a number of U.S. origin technology solutions under a single umbrella.
- **U.S. export potential:** The project introduces advanced US technologies which are highly competitive in terms of export potential. The broad based commercial application of these technologies will have a high US export value when applied across the industry in India. U.S. firms would be competitive for about \$80 million in annual sales throughout India in refinery inspection, testing and maintenance technologies and services, and approximately one-tenth that level for HPCL alone.

- **Energy Cooperation:** The project supports objectives of the U.S. Government in its relationship with Ministry of Petroleum and Natural Gas and is an initiative of US-India Energy Dialogue (Oil and Gas Working Group).

USTDA support for this AIM project will ensure that the needed technical assistance will be implemented by a US firm and that a range of US based technology and inspection services will be presented. This will improve the overall competitive position of US suppliers against foreign competition for follow-on procurement. In the absence of the USTDA grant, HPCL will be obligated to request the technical assistance through a competitive international tender process which would provide a greater opportunity to foreign companies at the expense of US suppliers.

L. Terms of Reference.

Introduction

Hindustan Petroleum Corporation Limited (HPCL), a public sector corporation under India's Ministry of Petroleum and Natural Gas, has a requirement for technical assistance and training for an **Asset Integrity Management** (AIM) program to be applied at its two wholly owned coastal refineries and associated pipelines and facilities in Mumbai and Vishakhapatnam. HPCL is seeking to upgrade its programs for refinery and pipeline inspection in conformity with continually improving best practices in the international petroleum industry, and in accordance with codes and standards set by the Government of India.

The intention of this work is to: (1) assess the prevailing inspection systems and techniques now undertaken by HPCL for asset integrity management; (2) recommend improvements with respect to systems and procedures; (3) recommend new inspection methodologies and technologies that will enhance the safety and the integrity of petroleum refining operations, and will better ensure the reliability of meeting its petroleum products supply obligations to the Indian market, and (4) demonstrate some of these advanced technologies.

Within the context of formulating an asset integrity management program utilizing modern state-of-the-art methodologies and technologies, HPCL has identified several specific areas of possible inquiry within the refineries, including:

1. Non-Destructive Technology (NDT) and procedures to assess the condition of insulated piping without the removal of insulation.
2. NDT / procedures for internal inspection of a 38 inch diameter jetty water line to assess the condition of the cement lining.
3. Real-Time On-Stream monitoring of critical pipelines and components carrying high sulphur crude or highly corrosive products using ultrasonic monitoring
4. Inspecting the condition of insulated columns without removing the insulation.
5. Complete internal / external inspection of studded convection tubes and boiler tubes.
6. Comprehensive inspection of reformer tubes with the help of Multi Probe crawler / Laser technique.

7. Assessing the condition of underground lines having bends without excavating the lines.
8. In-situ and laboratory techniques for assessing remaining life of furnace tubes, reactor - regenerator refractory lining, equipment operating in creep zones, etc.
9. Reliable condition assessment of bottom plates and shell for aboveground storage tanks including the application of new robotic inspection technologies.
10. Inspection of insulated tanks without the removal of insulation.
11. Integrity assessment of RCC structures.
12. On-stream inspection of tower internals for purposes of ascertaining tray dislodgement, etc.
13. Substitute (alternative materials) for cement lining in salt water and rubber lined pipes for improved corrosion protection.
14. Reliability assessment techniques for super duplex stainless steel tubes in coolers.

The Asset Integrity Management study shall evaluate the current status of HPCL inspection programs and plans, and recommend and demonstrate the use of advanced industry standard practices and technologies in selected areas. This work effort shall include a level one (L1) hands-on training program using the API 580 recommended practice and will highlight the resulting cost/benefits when utilizing advanced technology to improve reliability, safety, environmental control and refining throughput.

The API 580 Recommended Practice is the basis for all Asset Integrity Management as it provides the modeling requirements to understand, demonstrate, optimize and present the probabilities of failure and overall risk with each equipment item. Optimizing the model utilizing industry inspection practices and advanced technology to improve the probability of identifying failure mechanisms reduces the overall level of error within the model. As such API 580 Recommended Practice and associated modeling software is the basis for AIM analysis.

Three individual inspection standards exist which support the risk based inspection program. These standards include API 570 (Recommended Practice to Visually Inspect Associated Piping), API 510 (Recommended Practice to Visually Inspect Vessels and API 653 (Recommended Practice to Visually Inspect Above Ground Storage Tanks). The technology demonstration and

training shall utilize the risk based inspection program along with the above three inspection standards to demonstrate a process, procedure, methodology and resulting benefit of modeling risk.

Advanced technologies that are employed above and beyond visual inspection or that are utilized while the asset remains "in-service" shall be presented as part of the technical assistance. Emphasis will be on the fourteen (14) individual issues HPCL has presented as areas of concern and interest. At the same time several techniques which can feasibly be demonstrated during this study shall be offered. The results from these advanced inspection technologies shall employ the API 580 Risk Based Inspection model to show: (1) how advanced technology improves the understanding of risk and probability of failure, (2) how application of new technology can increase the interval between inspections to result in less operations downtime, increased refining throughput, and reduced cost; (3) how to assure unplanned outages do not occur causing significant reductions in petroleum product supply availability to the domestic market and financial loss to the company; (4) how new technology improves the understanding of mechanical conditions that enable the operator to more efficiently plan maintenance activities during planned outages, and (5) how risk based inspection will allow the operator to optimize and properly manage the refineries and avoid accidents and other unanticipated service disruptions that may include loss of life and environmental damage.

Scope-Of-Work

TASK 1: Initial Site Meeting and Survey

The Contractor team members shall travel to Mumbai, India to initiate work for the Grantee. The Grantee and the Contractor shall have a project kick-off meeting to address in-country work tasks, work schedules, and logistics.

The Contractor shall visit the Mumbai and Visakhapatnam refineries for a preliminary site survey, and to collect necessary data for the technical assistance. The Contractor shall meet with senior refinery operations, maintenance, and inspection officials to discuss current inspection programs being carried out at the two refineries.

TASK 2: Training Program

The Contractor shall conduct a one-week training program for Grantee officials at the Mumbai facilities of the Grantee (at the headquarters or refinery as determined by the Grantee). This training program shall consist of the following courses:

- a. Introduction to Integrity Asset Management

- b. Risk Based Inspection (API 580) Level I Training
- c. Analysis and Solutions to Grantee's 14 Points of Concern/Interest

The training courses shall introduce Asset Integrity Management focusing on a Level One (L1) API 580 Risk Based Inspection (RBI) Training program. The training shall concentrate on the process, procedures, modeling, results and optimization. Several equipment items will be presented and the start to finish process demonstrated during the training program. Two additional days shall be utilized to provide a brief introduction to American Petroleum Institute's (API) 510, 570 and 653 Inspection Standards. An additional three days shall be provided to present the benefits, limitations and requirements to utilize advanced technology including but not limited to: (1) Understanding Guided Wave Ultrasonics; (2) Understanding Acoustic Emission Testing, (3) Understanding In-Service Tank Inspection, and (4) Discuss and present solutions addressing the fourteen (14) points the Grantee has presented.

The Grantee, at its discretion, shall have the right to invite third parties to participate in the training. This may include officials from the Ministry of Petroleum and Natural Gas, other government regulatory officials, and officials from other refining companies in India. In order to protect proprietary information of the Contractor, individuals from companies that may offer competitive services and technologies to the Contractor may be invited to attend by the Grantee with the consent of the Contractor. The Contractor shall have the right to limit the number of participants (class size) in the training, and shall confer with the Grantee regarding the attendance limits to specific courses and demonstrations.

TASK 3A: Pilot Risk Based Inspection Implementation

The Contractor in a teaming effort with personnel to be designated by the Grantee shall conduct demonstration inspections at the Mumbai refinery that will highlight the advanced technologies and methodologies under consideration by the Grantee. This pilot inspection will take an estimated 30 days to implement. The purpose of the teaming arrangement is to provide the Grantee with a first hand view of new technology applications, implementation techniques, and evaluation criteria for optimizing an asset integrity management program.

The steps in this process shall include:

- Identifying 10 above ground storage tanks & associated piping
- Collecting necessary survey data on equipment
- Setting up a Risk Based Inspection (RBI) model for analysis
- Reviewing results of the models and identifying data required to improve model
- Performing conventional inspections required to improve model & assess results
- Identifying "Advanced Technology" to be utilized to improve the model

- Performing a “Cost/Benefit” analysis and cost justification for utilization of the advanced technology.

The ten (10) Above Ground Storage Tanks shall be identified following a quick overall analysis of all tanks. Two tanks with immediate concern, two tanks with moderate risk and six tanks with low risk will be selected for the analysis. All necessary data required to perform an RBI study shall be collected. Once the available data is identified, a model shall be developed for each individual tank. The models shall be run to calculate risk, probability of failure and cost to company if failure occurs. Additional data shall be collected on the tanks to show how additional information may improve modeling capabilities, and how the performance of further advanced testing might reduce risks to individual units at the refinery. The objectives of this task shall include demonstrating the effectiveness of an RBI program in performing cost / benefit analysis, and how such analysis will, in turn, demonstrate the cost advantages of utilizing advanced technologies.

TASK 3B: Advanced Technology Field Demonstrations

The Contractor shall conduct the following field demonstrations of advanced technologies at the Mumbai refinery.

- API 653 External Tank Inspections (Ten Tanks):
 - Settlement Surveys
 - Course Ultrasonic Testing (UT) Thickness Surveys
 - External Floating Roof (EFR) Seal Inspections
 - Visual Inspection
 - Reporting
- API 570 Associated Piping (Ten Tanks):
 - Corrosion Loops
 - Piping and Instrument Diagram (P&ID) Drawings
 - Thickness Measurement Location (TML) identification
 - TML Ultrasonic Testing (UT) Surveys
 - Profiler scans of insulated piping
 - Visual Inspection
 - Reporting
- Acoustic Emission (AE) Testing – (Ten Tanks):
 - Baseline AE Testing on Tanks to
 1. Determine Overall Damage
 2. Categorize A,B,C,D,E
 3. Show Technology

- In-Service Robotics – Two (2) Tanks:
 - Perform In-Service Robotic Testing
 - Measure actual wall loss
 - Perform EVA (Extreme Value Analysis)
 - Show technology

- In-Service Guided Wave Ultrasonic Testing (GWUT) (2,000 Meters):
 - Perform GWUT Set-Up
 - Perform GWUT Testing
 - Prove-Up GWUT Results
 - Perform EVA Analysis
 - Show Technology

- Lixi Profiler (or Alternative) scanning of Insulated In-service Piping
 - Technology Presentation (1 Day)
 - Perform Testing (1 Day)
 - Confirm Results with complimentary NDE technique(s)

- On-Stream Real Time Corrosion Monitoring (2 Installs):
 - Identify Points of Interest
 - Install Chirp UT Systems
 - Set up Communications
 - Present in Real-Time Web System
 - Show Modeling Features

For purposes of implementing Task 3, the Contractor shall need to import technology and equipment into India necessary to perform the demonstration inspections. At the end of this work, the Contractor shall be permitted to re-export the technology and equipment. The Grantee shall assist the Contractor in securing all Central Government, State Government, and local government permits, and customs privileges necessary to enable the Contractor to import and re-export the technology and equipment on a timely basis. The costs of all such Indian permits, taxes and duties applicable to importing, re-exporting and otherwise utilizing this technology and equipment in this project shall be outside the funds to be provided by USTDA, and shall be the responsibility of the Grantee. The costs of transporting, mobilizing and demobilizing this equipment shall be a cost element within the approved budget for this project.

As in the case of Task 2, the Grantee may invite third parties to participate in the inspection implementation and field demonstrations subject to the same terms and conditions as stated in Task 2 (above).

TASK 4: Conduct Technical Evaluation

The Contractor shall utilize results from the above visual inspections and advanced testing to perform the following analyses:

- Update/optimize model to show real risk
- Calculate next inspection intervals
- Calculate next maintenance intervals
- Determine overall maintenance requirements

TASK 5: Preliminary Environmental Impact Assessment

The Contractor shall assess the environmental impact of applying advanced technologies and methodologies for refinery inspection. This impact analysis shall take account of potential loss prevention relative benefits and risks in such areas as release of toxic and other environmentally damaging substances into the air, ground and water due to leaks, accidents, and other unanticipated events.

TASK 6: Development Impact Assessment

The Contractor shall provide an assessment of the potential development impact of the project. Specific areas to be addressed shall be:

Infrastructure

- Contractor shall summarize how the recommended investments will result in improvements to refinery throughput, security of petroleum product supply, and integrity of the refinery and associated infrastructure.

Human Capacity Building

- Contractor shall summarize the incremental additional local employment and skill development that will be generated as a result of the application of an asset integrity management program at the Mumbai and Vishakhapatnam refineries.

Productivity and Technology Transfer

- Contractor shall identify the new technologies being provided to the project and note any specific "technology transfer" which has occurred by virtue of this project.
- Contractor shall provide an estimate of the productivity gains and safety improvements in the refineries through the implementation of improved technology and methodologies for refinery inspection.

The Contractor shall summarize any benefits identified in the area of **Market Oriented Reform** or other developmental benefits of the project.

TASK 7: Prepare Cost Estimates and Economic Assessment

The Contractor shall prepare an estimate of the investment required by the Grantee to obtain the technologies needed to implement a long-term comprehensive asset integrity management program through equipment acquisitions and/or turnkey contracting.

This assessment shall take into account internal manpower requirements, training, equipment and other costs associated with establishing and maintaining an asset integrity management program. The Contractor shall not be required to estimate long-term costs of applying remedial measures recommended by the future inspections.

The purpose of this task is to provide the Grantee with cost guidelines for project implementation; however, decisions on equipment acquisitions and / or turnkey contracting shall be at the sole discretion of the Grantee, and procurement recommendations in the Contractor report will not be binding on the Grantee.

TASK 8: Equipment and Technology Suppliers

The Contractor shall prepare a list of reputed U.S. firms that are potential suppliers of the equipment, technologies, and services recommended in this study. This list shall include the names and addresses of the firms, as well as key contact information.

TASK 9: Training Program Recommendations

The Contractor shall recommend immediate and long-term training programs for application by the Grantee for its personnel covering the various facets of asset integrity management for the petroleum refining sector. The training program recommended shall include classroom courses, field demonstrations, orientation visits and other activities in conformity with those supported or endorsed by leading industry organizations such as API, the National Petroleum Refiners Association (NPRA), the Pipeline Research Council International (PRCI), and ASME.

TASK 10: Deliverables and Reporting

Contractor shall submit to the Grantee a brief **Inception Report** at the conclusion of Task 1. This report will briefly outline Contractor's work plan, consistent with the feasibility study Terms of Reference, and any outstanding issues pertaining to logistics for the project.

The Contractor shall submit brief **Monthly Reports** to the Grantee that will identify the progress of work, and any impediments to work that will affect the

time schedule for completion of the technical assistance. Communication between the Contractor and the Grantee on this matter is essential.

The Contractor shall prepare a **Draft Final Report** for the Grantee. Five copies of this draft report shall be submitted to the Grantee upon completion. Contractor shall make a Power Point type presentation of the Draft Final Report to Grantee at Grantee's offices in India. Grantee shall provide written comments to Contractor within two weeks of Contractor's presentation. The Contractor shall make the necessary changes and modifications to the Draft Final Report.

The Contractor shall submit a **Final Report** on the technical assistance project that shall address all elements in the Terms of Reference.

Contractor will provide Grantee with 10 printed copies of the Final Report. Contractor will provide USTDA with four printed copies of the final report as follows:

(a) One (1) complete version of the Final Report for USTDA's records. This version shall have been approved by the Grantee in writing and must be in the English language. It is the responsibility of the Contractor to ensure that confidential information, if any, contained in this version be clearly marked. USTDA will maintain the confidentiality of such information in accordance with applicable law; and

(b) Three (3) copies of the Final Report suitable for public distribution ("Public Version"). The Public Version shall have been approved by the Client in writing and must be in the English language. As this version will be available for public distribution, it must not contain any confidential information. If the report in (a) above contains no confidential information, it may be used as the Public Version (provided USTDA receives a total of four (4) copies). In any event, the Public Version must be informative and contain sufficient Project detail to be useful to prospective equipment and service providers.

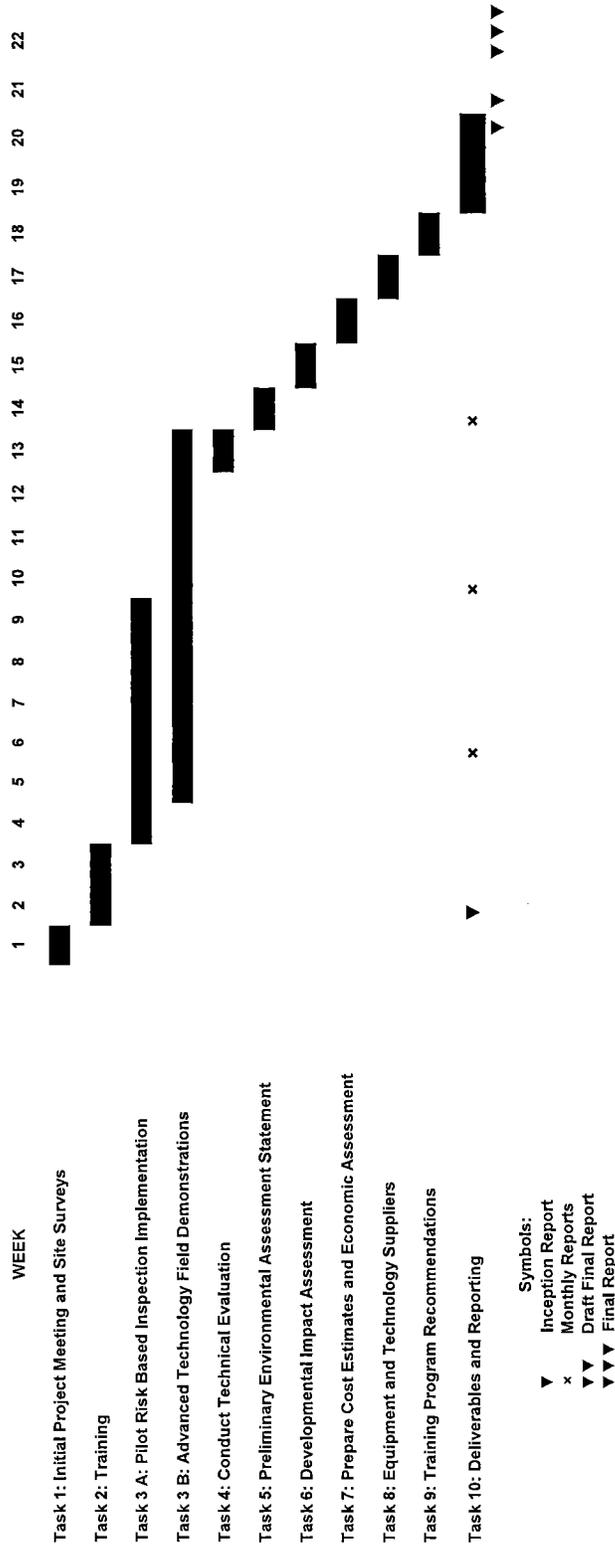
The Contractor shall also provide one (1) copy of the Public Version of the Final Report to the Foreign Commercial Service Officer in Mumbai and the Economic Section of the U.S. Embassy in New Delhi, India for informational purposes.

Contractor will provide both the Grantee and USTDA with 6 copies (each) of the final report on CD-ROM. The CD-ROM version of the final report will include:

- Adobe Acrobat readable copies of all documents;
- Source files for all drawings in AutoCAD or Visio format; and
- Source files for all documents in MS Office 2000 or later format

Technical Assistance Schedule

HPCL Asset Integrity Management Technical Assistance -- Estimated Schedule of Activities



Technical Assistance Budget

The proposed technical assistance to HPCL for a comprehensive asset integrity management program is unique because it covers a broad scope of activities and U.S. based technologies for inspection. The technologies to be presented in on-site training and field demonstrations are derived from several different U.S. manufacturers and cover a complete range in state-of-the art equipment for modern refinery inspection services. To demonstrate each advanced methodology that will be employed in this technical assistance requires specialists that are certified in application of that respective technology. The training needs to be carried out by instructors that have strong training skills and prior experience in presenting the topics that will be addressed. MT Energy Associates estimates that in total eight (8) U.S. experts will be required to implement the technical assistance and cumulatively cover all of the 14 assessment areas identified by HPCL, as well as the specific U.S. technologies for which HPCL has requested a review.

This staffing plan has a labor component and related travel and living expenses that would be considered high cost for the analysis and demonstration of one or two technologies, but quite reasonable for the range of technologies that will form this technical assistance. Another cost element is the charge for freight to crate and ship the equipment to India and to subsequently re-export it to the United States. The freight cost is based on packaging all of the equipment in a single container, and the freight rate takes account of the volume and weight of the shipment.

The labor rates quoted are conventional for U.S. specialists performing those respective services in the industry. Higher maritime rates are justified for the specialist in Guided Wave Ultrasonic Testing (GWUT) and the Tank Technician who will be operating a new unique robotic tool to remotely examine the inside of crude oil and petroleum product storage tanks without having to first drain the tanks. Local Indian subcontract labor will be used to support carrying out some of the complex technology demonstrations.

The scope of work calls for ten (10) roundtrip International airfares between the United States and Mumbai, India and two roundtrip domestic airfares from Mumbai to Visakhapatnum. All air travel is priced in economy class with refundable tickets. Lodging and meals are at current U.S. Government per diem rates.

The estimated technical assistance budget is US\$ 610,926.

Asset Integrity Management Feasibility Study For HPCL
 Budgetary Cost Estimate and Resource Utilization per Task

LABOR:	Project	RBI	API	AE	GWUT	NACE	Tank	Local Labor		Total Labor
								Inspector (2)	Technician	
Labor Rate Per Hour	Manager \$ 75.00	Engineer \$ 150.00	Inspectors (2) \$ 75.00	Technician \$ 150.00	Technician \$ 250.00	Technician \$ 75.00	Technician \$ 185.00	\$ 30.00		
Manhours	190	1,030	400	270	180	120	180	200		
Task I	\$5,250.00	\$16,500.00								\$21,750.00
Task II Training	\$3,750.00	\$13,500.00								\$17,250.00
Task IIIA RBI Implementations		\$61,500.00	\$30,000.00	\$40,500.00						\$132,000.00
Task IIIB GWUT & InTank Demos		\$24,000.00			\$45,000.00	\$9,000.00	\$33,300.00	\$6,000.00		\$117,300.00
Task IV Tech. Evaluations		\$7,500.00								\$7,500.00
Task V Environmental Assessment		\$4,500.00								\$4,500.00
Task VI Impact Assessment		\$4,500.00								\$4,500.00
Task VII Economic Assessment		\$4,500.00								\$4,500.00
Task VIII Equip & Suppliers Rpt		\$4,500.00								\$4,500.00
Task IX Training Recommendations		\$3,000.00								\$3,000.00
Task X - Final Report	\$5,250.00	\$10,500.00								\$15,750.00
Project Labor	\$14,250.00	\$154,500.00	\$30,000.00	\$40,500.00	\$45,000.00	\$9,000.00	\$33,300.00	\$6,000.00		\$332,550.00

BUDGET SUMMARY:

TOTAL PROJECT LABOR **\$ 332,550.00**

OTHER DIRECT EXPENSES

Equipment:	Cost	Comments	
API Inspection Equipment	\$ 1,200.00	Rental Charges	
AE Equipment	\$ 28,000.00	Rental Charges	
GWUT Equipment	\$ 28,152.00	Rental Charges	
CHIRP Equipment	\$ 20,000.00	Equipment to remain with HPCL	
In-Tank Equipment	\$ 60,000.00	Rental Charges	
Freight (shipment to India) ^{1/}	\$ 52,500.00		
Subtotal Equipment			\$ 189,852.00

Travel:	Number of	Cost Per	
	Trips / Days	Trip / Day	Total Cost
International Airfare	10 \$	3,500.00	\$ 35,000.00
Per Diem	126 \$	386.00	\$ 48,636.00
Local Transportation (HPCL)	\$	-	\$ -
Visas for India	8 \$	86.00	\$ 688.00
Subtotal Travel			\$ 84,324.00

Miscellaneous:			
Communications	\$ 1,200.00		
Printing and Reproduction	\$ 3,000.00		
Subtotal Miscellaneous			\$ 4,200.00

TOTAL PROJECT COST **\$ 610,926.00**

^{1/} All equipment will be crated and shipped in one container round trip -- Estimate based on volume and weight

M. Recommendations.

MT Energy Associates has evaluated the requirements for the proposed asset integrity management (AIM) technical assistance, and has formulated a scope-of-work designed to accomplish the goals of the proposed Grantee in India Hindustan Petroleum Corporation Limited (HPCL). The scope of work has been reviewed by HPCL and they concur regarding the various defined tasks and project schedule. We also have conferred with several U.S. technology providers, oil field services companies, training organizations, and industry associations to ensure that the scope of work and strategy for introducing technologies and methodologies for inspection are in conformity with best practices and standards for the industry. On that basis, MT Energy Associates has formulated a budget for the technical assistance.

MT Energy Associates recommends that the U.S. Trade and Development Agency (USTDA) provide grant funding for this technical assistance. The project meets a number of key criteria set by USTDA and it will have a positive impact.

- The technical assistance is a valuable capacity building project that will enhance the capability of HPCL personnel to better manage its safety programs for its major refineries. The work will include specialized training that will improve skill sets and have a positive development impact.
- Implementation of the programs and technologies as a permanent component of its safety management will enable HPCL to ensure refinery throughput on a continuous basis and minimize potentially catastrophic risks to its refinery assets, thus improving domestic energy security and the reliability of petroleum product supplies to domestic markets in India.
- The commercial acquisition of imported technology, equipment and services in implementation of a comprehensive AIM program will provide substantial opportunity for U.S. suppliers.
- The technical assistance will provide a unique opportunity to showcase several different advanced U.S. technologies and services to the Indian refining sector under one umbrella, and is a very cost effective approach in support of U.S. commercial interests to increase exports. It also will provide exposure to U.S. advanced technology which competes with foreign companies.
- The training and field demonstrations will be open to a few select individuals from other Indian refining companies and to the Oil Industry Safety Directorate (OISD). This will serve as a template for the broader application of AIM to the entire refining sector, and OISD will be able to evaluate how these improved methodologies and technologies can be integrated into the existing codes and standards set by the regulator.
- OISD has expressed a positive interest in this technical assistance project.
- HPCL has the financial capability to implement the recommendations of this work, and to acquire the recommended technologies from its internal

- financial resources. HPCL senior officials have indicated that this is a priority.
- This work would constitute a potential deliverable under the U.S.-India Energy Dialogue for the Oil & Gas Working Group to the extent it supports improvements in regulatory codes and standards by the Government of India.

The estimated budget for the AIM technical assistance is US\$ 610,926. Of this total, the U.S. labor component is approximately US\$ 326,550, with a very small additional increment (US\$ 6,000) for local subcontract services. We have evaluated the labor rates and find them to be reasonable given the various levels of expertise of the technical assistance staff. Because this work will involve on-site inspections at the Mumbai refinery and demonstrations of a number of different U.S. technologies, the costs for equipment, crating and shipping charges are cumulatively high – almost \$190,000. To be available for this project, the equipment will have to be taken out of commercial service for months. U.S. manufacturers generally do not stockpile this equipment, and the manufacture is based on procurement orders from services contractors. On this basis, the charges appear justified. Airfares and per diem rates are based on U.S. Government guidelines. All equipment will be re-exported to the United States at the completion of work, with the exception of the installed Chirp equipment used for real-time corrosion monitoring that will be left behind.

It is the intention of HPCL to competitively bid this technical assistance project among U.S. firms. While a large number of U.S. firms have access to portions of the requisite skills and technologies, only a relatively small number will have the full set of capabilities identified in the detailed Qualifications (Section J above) to implement the full scope of work, including inspections, training and on-site demonstrations of the complete range of technologies.

We have discussed the options with HPCL of their decision to competitively bid the technical assistance among U.S. firms vs. selecting a sole source U.S. Contractor on a nomination basis (open competitive bidding generally is a preferred practice). Our concern in this case related to whether HPCL already has a single U.S. Contractor in mind and is merely going through the formalities of a competitive bid to avoid cost share obligations. This approach will stretch out the time for bids to be solicited and evaluated before a U.S. company is selected, and it would unnecessarily cause unsuccessful bidders to incur cost. Having discussed this issue with HPCL, we now believe that it will fairly evaluate all bids. The principal reason given by HPCL for preferring the USTDA assistance on a full grant basis is so that it can avoid bureaucratic delays that otherwise would likely take place within the Government of India, a process which HPCL envisions will take far longer than going through a competitive bid process.

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Mr. J. B. Verma
Executive Director
Oil Industry Safety Directorate (OISD)
Ministry of Petroleum and Natural Gas
7th Floor, New Delhi House
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New Delhi 110 001 India
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ANNEX 3



**U.S. TRADE AND DEVELOPMENT AGENCY
Arlington, VA 22209-2131**

NATIONALITY, SOURCE, AND ORIGIN REQUIREMENTS

The purpose of USTDA's nationality, source, and origin requirements is to assure the maximum practicable participation of American contractors, technology, equipment and materials in the prefeasibility, feasibility, and implementation stages of a project.

USTDA STANDARD RULE (GRANT AGREEMENT STANDARD LANGUAGE):

Except as USTDA may otherwise agree, each of the following provisions shall apply to the delivery of goods and services funded by USTDA under this Grant Agreement: (a) for professional services, the Contractor must be either a U.S. firm or U.S. individual; (b) the Contractor may use U.S. subcontractors without limitation, but the use of subcontractors from host country may not exceed twenty percent (20%) of the USTDA Grant amount and may only be used for specific services from the Terms of Reference identified in the subcontract; (c) employees of U.S. Contractor or U.S. subcontractor firms responsible for professional services shall be U.S. citizens or non-U.S. citizens lawfully admitted for permanent residence in the U.S.; (d) goods purchased for implementation of the Study and associated delivery services (e.g., international transportation and insurance) must have their nationality, source and origin in the United States; and (e) goods and services incidental to Study support (e.g., local lodging, food, and transportation) in host country are not subject to the above restrictions. USTDA will make available further details concerning these standards of eligibility upon request.

NATIONALITY:

1) Rule

Except as USTDA may otherwise agree, the Contractor for USTDA funded activities must be either a U.S. firm or a U.S. individual. Prime contractors may utilize U.S.

subcontractors without limitation, but the use of host country subcontractors is limited to 20% of the USTDA grant amount.

2) Application

Accordingly, only a U.S. firm or U.S. individual may submit proposals on USTDA funded activities. Although those proposals may include subcontracting arrangements with host country firms or individuals for up to 20% of the USTDA grant amount, they may not include subcontracts with third country entities. U.S. firms submitting proposals must ensure that the professional services funded by the USTDA grant, to the extent not subcontracted to host country entities, are supplied by employees of the firm or employees of U.S. subcontractor firms who are U.S. individuals.

Interested U.S. firms and consultants who submit proposals must meet USTDA nationality requirements as of the due date for the submission of proposals and, if selected, must continue to meet such requirements throughout the duration of the USTDA-financed activity. These nationality provisions apply to whatever portion of the Terms of Reference is funded with the USTDA grant.

3) Definitions

A "U.S. individual" is (a) a U.S. citizen, or (b) a non-U.S. citizen lawfully admitted for permanent residence in the U.S. (a green card holder).

A "U.S. firm" is a privately owned firm which is incorporated in the U.S., with its principal place of business in the U.S., and which is either (a) more than 50% owned by U.S. individuals, or (b) has been incorporated in the U.S. for more than three (3) years prior to the issuance date of the request for proposals; has performed similar services in the U.S. for that three (3) year period; employs U.S. citizens in more than half of its permanent full-time positions in the U.S.; and has the existing capability in the U.S. to perform the work in question.

A partnership, organized in the U.S. with its principal place of business in the U.S., may also qualify as a "U.S. firm" as would a joint venture organized or incorporated in the United States consisting entirely of U.S. firms and/or U.S. individuals.

A nonprofit organization, such as an educational institution, foundation, or association may also qualify as a "U.S. firm" if it is incorporated in the United States and managed by a governing body, a majority of whose members are U.S. individuals.

SOURCE AND ORIGIN:

1) Rule

In addition to the nationality requirement stated above, any goods (e.g., equipment and materials) and services related to their shipment (e.g., international transportation and insurance) funded under the USTDA Grant Agreement must have their source and origin in the United States, unless USTDA otherwise agrees. However, necessary purchases of goods and project support services which are unavailable from a U.S. source (e.g., local food, housing and transportation) are eligible without specific USTDA approval.

2) Application

Accordingly, the prime contractor must be able to demonstrate that all goods and services purchased in the host country to carry out the Terms of Reference for a USTDA Grant Agreement that were not of U.S. source and origin were unavailable in the United States.

3) Definitions

“Source” means the country from which shipment is made.

“Origin” means the place of production, through manufacturing, assembly or otherwise.

Questions regarding these nationality, source and origin requirements may be addressed to the USTDA Office of General Counsel.

ANNEX 4

USTDA # 08.31018A

GRANT AGREEMENT

U.S. TRADE AND DEVELOPMENT AGENCY	
PE/REG	APR - 7 2008
JN, DW, EK	

This Grant Agreement is entered into between the Government of the United States of America, acting through the U.S. Trade and Development Agency ("USTDA") and Hindustan Petroleum Corporation Limited ("Grantee"). USTDA agrees to provide the Grantee under the terms of this Agreement US\$628,926 ("USTDA Grant") to fund the cost of goods and services required for technical assistance ("TA") for the proposed HPCL Asset Integrity Management Project ("Project") in India ("Host Country").

1. USTDA Funding

The funding to be provided under this Grant Agreement shall be used to fund the costs of a contract between the Grantee and the U.S. firm selected by the Grantee ("Contractor") under which the Contractor will perform the Study ("Contract"). Payment to the Contractor will be made directly by USTDA on behalf of the Grantee with the USTDA Grant funds provided under this Grant Agreement.

2. Terms of Reference

The Terms of Reference for the Study ("Terms of Reference") are attached as Annex I and are hereby made a part of this Grant Agreement. The Study will examine the technical, financial, environmental, and other critical aspects of the proposed Project. The Terms of Reference for the Study shall also be included in the Contract.

3. Standards of Conduct

USTDA and the Grantee recognize the existence of standards of conduct for public officials, and commercial entities, in their respective countries. The parties to this Grant Agreement and the Contractor shall observe these standards, which include not accepting payment of money or anything of value, directly or indirectly, from any person for the purpose of illegally or improperly inducing anyone to take any action favorable to any party in connection with the Study.

4. Grantee Responsibilities

The Grantee shall undertake its best efforts to provide reasonable support for the Contractor, such as local transportation, office space, and secretarial support.

5. USTDA as Financier

(A) USTDA Approval of Competitive Selection Procedures

Selection of the U.S. Contractor shall be carried out by the Grantee according to its established procedures for the competitive selection of contractors with advance notice of the procurement published online through *Federal Business Opportunities* (www.fedbizopps.gov). Upon request, the Grantee will submit these contracting procedures and related documents to USTDA for information and/or approval.

(B) USTDA Approval of Contractor Selection

The Grantee shall notify USTDA at the address of record set forth in Article 17 below upon selection of the Contractor to perform the Study. Upon approval of this selection by USTDA, the Grantee and the Contractor shall then enter into a contract for performance of the Study. The Grantee shall notify in writing the U.S. firms that submitted unsuccessful proposals to perform the Study that they were not selected.

(C) USTDA Approval of Contract Between Grantee and Contractor

The Grantee and the Contractor shall enter into a contract for performance of the Study. This contract, and any amendments thereto, including assignments and changes in the Terms of Reference, must be approved by USTDA in writing. To expedite this approval, the Grantee (or the Contractor on the Grantee's behalf) shall transmit to USTDA, at the address set forth in Article 17 below, a photocopy of an English language version of the signed contract or a final negotiated draft version of the contract.

(D) USTDA Not a Party to the Contract

It is understood by the parties that USTDA has reserved certain rights such as, but not limited to, the right to approve the terms of the contract and any amendments thereto, including assignments, the selection of all contractors, the Terms of Reference, the Final Report, and any and all documents related to any contract funded under the Grant Agreement. The parties hereto further understand and agree that USTDA, in reserving any or all of the foregoing approval rights, has acted solely as a financing entity to assure the proper use of United States Government funds, and that any decision by USTDA to exercise or refrain from exercising these approval rights shall be made as a financier in the course of funding the Study and shall not be construed as making USTDA a party to the contract. The parties hereto understand and agree that USTDA may, from time to time, exercise the foregoing approval rights, or discuss matters related to these rights and the Project with the parties to the contract or any subcontract, jointly or separately, without thereby incurring any responsibility or liability to such parties. Any approval or failure to approve by USTDA shall not bar the Grantee or USTDA from asserting any right they might have against the

Contractor, or relieve the Contractor of any liability which the Contractor might otherwise have to the Grantee or USTDA.

(E) Grant Agreement Controlling

Regardless of USTDA approval, the rights and obligations of any party to the contract or subcontract thereunder must be consistent with this Grant Agreement. In the event of any inconsistency between the Grant Agreement and any contract or subcontract funded by the Grant Agreement, the Grant Agreement shall be controlling.

6. Disbursement Procedures

(A) USTDA Approval of Contract Required

USTDA will make disbursements of Grant funds directly to the Contractor only after USTDA approves the Grantee's contract with the Contractor.

(B) Contractor Invoice Requirements

The Grantee should request disbursement of funds by USTDA to the Contractor for performance of the Study by submitting invoices in accordance with the procedures set forth in the USTDA Mandatory Clauses in Annex II.

7. Effective Date

The effective date of this Grant Agreement ("Effective Date") shall be the date of signature by both parties or, if the parties sign on different dates, the date of the last signature.

8. Study Schedule

(A) Study Completion Date

The completion date for the Study, which is December 31, 2008, is the date by which the parties estimate that the Study will have been completed.

(B) Time Limitation on Disbursement of USTDA Grant Funds

Except as USTDA may otherwise agree, (a) no USTDA funds may be disbursed under this Grant Agreement for goods and services which are provided prior to the Effective Date of the Grant Agreement; and (b) all funds made available under the Grant Agreement must be disbursed within four (4) years from the Effective Date of the Grant Agreement.

9. USTDA Mandatory Clauses

All contracts funded under this Grant Agreement shall include the USTDA mandatory clauses set forth in Annex II to this Grant Agreement. All subcontracts funded or partially funded with USTDA Grant funds shall include the USTDA mandatory clauses, except for clauses B(1), G, H, I, and J.

10. Use of U.S. Carriers

(A) Air

Transportation by air of persons or property funded under the Grant Agreement shall be on U.S. flag carriers in accordance with the Fly America Act, 49 U.S.C. 40118, to the extent service by such carriers is available, as provided under applicable U.S. Government regulations.

(B) Marine

Transportation by sea of property funded under the Grant Agreement shall be on U.S. carriers in accordance with U.S. cargo preference law.

11. Nationality, Source and Origin

Except as USTDA may otherwise agree, the following provisions shall govern the delivery of goods and services funded by USTDA under the Grant Agreement: (a) for professional services, the Contractor must be either a U.S. firm or U.S. individual; (b) the Contractor may use U.S. subcontractors without limitation, but the use of subcontractors from Host Country may not exceed twenty percent (20%) of the USTDA Grant amount and may only be used for specific services from the Terms of Reference identified in the subcontract; (c) employees of U.S. Contractor or U.S. subcontractor firms responsible for professional services shall be U.S. citizens or non-U.S. citizens lawfully admitted for permanent residence in the U.S.; (d) goods purchased for performance of the Study and associated delivery services (e.g., international transportation and insurance) must have their nationality, source and origin in the United States; and (e) goods and services incidental to Study support (e.g., local lodging, food, and transportation) in Host Country are not subject to the above restrictions. USTDA will make available further details concerning these provisions upon request.

12. Taxes

USTDA funds provided under the Grant Agreement shall not be used to pay any taxes, tariffs, duties, fees or other levies imposed under laws in effect in Host Country. Neither the Grantee nor the Contractor will seek reimbursement from USTDA for such taxes, tariffs, duties, fees or other levies.

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13. Cooperation Between Parties and Follow-Up

The parties will cooperate to assure that the purposes of the Grant Agreement are accomplished. For five (5) years following receipt by USTDA of the Final Report (as defined in Clause I of Annex II), the Grantee agrees to respond to any reasonable inquiries from USTDA about the status of the Project.

14. Implementation Letters

To assist the Grantee in the implementation of the Study, USTDA may, from time to time, issue implementation letters that will provide additional information about matters covered by the Grant Agreement. The parties may also use jointly agreed upon implementation letters to confirm and record their mutual understanding of matters covered by the Grant Agreement.

15. Recordkeeping and Audit

The Grantee agrees to maintain books, records, and other documents relating to the Study and the Grant Agreement adequate to demonstrate implementation of its responsibilities under the Grant Agreement, including the selection of contractors, receipt and approval of contract deliverables, and approval or disapproval of contractor invoices for payment by USTDA. Such books, records, and other documents shall be separately maintained for three (3) years after the date of the final disbursement by USTDA. The Grantee shall afford USTDA or its authorized representatives the opportunity at reasonable times to review books, records, and other documents relating to the Study and the Grant Agreement.

16. Representation of Parties

For all purposes relevant to the Grant Agreement, the Government of the United States of America will be represented by the U. S. Ambassador to Host Country or USTDA and Grantee will be represented by the General Manager--Technical. The parties hereto may, by written notice, designate additional representatives for all purposes under the Grant Agreement.

17. Addresses of Record for Parties

Any notice, request, document, or other communication submitted by either party to the other under the Grant Agreement shall be in writing or through a wire or electronic medium which produces a tangible record of the transmission, such as a telegram, cable or facsimile, and will be deemed duly given or sent when delivered to such party at the following:

To: Mr. S. C. Mehta
General Manager – Technical

dm

Hindustan Petroleum Corporation Ltd.
B.D. Patil Marg
Mahul, Mumbai 400-074, India

Phone: 011 91 22 2554 3482
Fax: 011 91 22 2554 4584
E-mail: scmehta@hpcl.co.in

To: U.S. Trade and Development Agency
1000 Wilson Boulevard, Suite 1600
Arlington, Virginia 22209-3901
USA

Phone: (703) 875-4357
Fax: (703) 875-4009

All such communications shall be in English, unless the parties otherwise agree in writing. In addition, the Grantee shall provide the Commercial Section of the U.S. Embassy in Host Country with a copy of each communication sent to USTDA.

Any communication relating to this Grant Agreement shall include the following fiscal data:

Appropriation No.: 118/91001
Activity No.: 2008-31018A
Reservation No.: 2008310026
Grant No.: GH2008310004

18. Termination Clause

Either party may terminate the Grant Agreement by giving the other party thirty (30) days advance written notice. The termination of the Grant Agreement will end any obligations of the parties to provide financial or other resources for the Study, except for payments which they are committed to make pursuant to noncancellable commitments entered into with third parties prior to the written notice of termination.



19. Non-waiver of Rights and Remedies

No delay in exercising any right or remedy accruing to either party in connection with the Grant Agreement shall be construed as a waiver of such right or remedy.

20. U.S. Technology and Equipment

By funding this Study, USTDA seeks to promote the project objectives of the Host Country through the use of U.S. technology, goods, and services. In recognition of this purpose, the Grantee agrees that it will allow U.S. suppliers to compete in the procurement of technology, goods and services needed for Project implementation.

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IN WITNESS WHEREOF, the Government of the United States of America and Hindustan Petroleum Corporation Limited, each acting through its duly authorized representative, have caused this Agreement to be signed in the English language in their names and delivered as of the day and year written below. In the event that this Grant Agreement is signed in more than one language, the English language version shall govern.

**For the Government of the
United States of America**

By: 
Henry Steingass, Regional Director
South and Southeast Asia, USTDA

Date: 4 April 2008

**For Hindustan Petroleum
Corporation Limited**

By: 
M A Tankiwala, Director-Refineries

Date: 4th April 2008

Witnessed:

By: 

Witnessed:

By: 

Annex I -- Terms of Reference

Annex II -- USTDA Mandatory Clauses



Annex I

Terms of Reference

Introduction

The Grantee, a public sector corporation under India's Ministry of Petroleum and Natural Gas, has a requirement for technical assistance and training for an Asset Integrity Management (AIM) program to be applied at its two wholly owned coastal refineries and associated pipelines and facilities in Mumbai and Vishakhapatnam. The Grantee is seeking to upgrade its programs for refinery and pipeline inspection in conformity with continually improving best practices in the international petroleum industry, and in accordance with codes and standards set by the Government of India.

The intention of this work is to: (1) assess the prevailing inspection systems and techniques now undertaken by the Grantee for asset integrity management; (2) recommend improvements with respect to systems and procedures; (3) recommend new inspection methodologies and technologies that will enhance the safety and the integrity of petroleum refining operations, and will better ensure the reliability of meeting its petroleum products supply obligations to the Indian market; and (4) demonstrate some of these advanced technologies.

Within the context of formulating an asset integrity management program utilizing modern state-of-the-art methodologies and technologies, the Grantee has identified several specific areas of possible inquiry within the refineries, including:

1. Non-destructive technology (NDT) and procedures to assess the condition of insulated piping without the removal of insulation.
2. NDT / procedures for internal inspection of a 38 inch diameter jetty water line to assess the condition of the cement lining.
3. Real-time on-stream monitoring of critical pipelines and components carrying high-sulfur crude or highly corrosive products using ultrasonic monitoring.
4. Inspecting the condition of insulated columns without removing the insulation.
5. Complete internal / external inspection of studded convection tubes and boiler tubes.
6. Comprehensive inspection of reformer tubes with the help of multi-probe crawler / laser technique.
7. Assessing the condition of underground lines having bends without excavating the lines.



8. In-situ and laboratory techniques for assessing remaining life of furnace tubes, reactor - regenerator refractory lining, equipment operating in creep zones, etc.
9. Reliable condition assessment of bottom plates and shell for aboveground storage tanks including the application of new robotic inspection technologies.
10. Inspection of insulated tanks without the removal of insulation.
11. Integrity assessment of residual catalytic cracking (RCC) structures.
12. On-stream inspection of tower internals for purposes of ascertaining tray dislodgement, etc.
13. Substitute (alternative materials) for cement lining in salt water and rubber lined pipes for improved corrosion protection.
14. Reliability assessment techniques for super duplex stainless steel tubes in coolers.

The AIM study shall evaluate the current status of the Grantee's inspection programs and plans, and recommend and demonstrate the use of advanced industry standard practices and technologies in selected areas. This work effort shall include a level one (L1) hands-on training program using the American Petroleum Institute (API) 580 Recommended Practice and will highlight the resulting cost/benefits when utilizing advanced technology to improve reliability, safety, environmental control and refining throughput.

The API 580 Recommended Practice and associated modeling software are the basis for all AIM, as they provide the modeling requirements to understand, demonstrate, optimize and present the probabilities of failure and overall risk with each equipment item. Optimizing the model utilizing industry inspection practices and advanced technology to improve the probability of identifying failure mechanisms reduces the overall level of error within the model.

Three individual inspection standards exist which support this risk-based inspection (RBI) program. These standards include API 570 (Recommended Practice to Visually Inspect Associated Piping), API 510 (Recommended Practice to Visually Inspect Vessels and API 653 (Recommended Practice to Visually Inspect Above-Ground Storage Tanks). The technology demonstration and training shall utilize the risk-based inspection program along with the above three inspection standards to demonstrate a process, procedure, methodology and resulting benefit of modeling risk.

Advanced technologies that are employed above and beyond visual inspection or that are utilized while the asset remains "in-service" shall be presented as part of the technical assistance. Emphasis will be on the fourteen (14) individual issues the Grantee has presented as areas of concern and interest mentioned above. At the same time several techniques which can feasibly be demonstrated during this study shall be offered. The results from these advanced inspection technologies shall employ the API 580 Risk-

Based Inspection model to show: (1) how advanced technology improves the understanding of risk and probability of failure; (2) how application of new technology can increase the interval between inspections to result in less operations downtime, increased refining throughput, and reduced cost; (3) how to assure unplanned outages do not occur causing significant reductions in petroleum product supply availability to the domestic market and financial loss to the company; (4) how new technology improves the understanding of mechanical conditions that enable the operator to more efficiently plan maintenance activities during planned outages; and (5) how risk-based inspection will allow the operator to optimize and properly manage the refineries and avoid accidents and other unanticipated service disruptions that may include loss of life and environmental damage.

Scope-Of-Work

TASK 1: Initial Site Meeting and Survey

The Contractor team members shall travel to Mumbai, India to initiate work for the Grantee. The Grantee and the Contractor shall have a project kick-off meeting to address in-country work tasks, work schedules, and logistics.

The Contractor shall visit the Mumbai and Visakhapatnam refineries for a preliminary site survey, and to collect necessary data for the TA. The Contractor shall meet with senior refinery operations, maintenance, and inspection officials to discuss current inspection programs being carried out at the two refineries.

Deliverables: The Contractor shall submit to the Grantee a brief **Inception Report** at the conclusion of Task 1. This report will briefly outline Contractor's work plan, consistent with these Terms of Reference, and any outstanding issues pertaining to logistics for the project.

Throughout the course of this TA, the Contractor shall submit brief **Monthly Reports** to the Grantee that will identify the progress of work, and any impediments to work that will affect the time schedule for completion of the TA. Communication between the Contractor and the Grantee on this matter is essential.

TASK 2: Training Program

The Contractor shall conduct a one-week training program for Grantee officials at the Mumbai facilities of the Grantee (at the headquarters or refinery as determined by the Grantee). This training program shall consist of the following courses:

- a. Introduction to AIM
- b. Risk-Based Inspection (API 580) Level I Training
- c. Analysis and Solutions to the Grantee's 14 Points of Concern/Interest



The training courses shall introduce AIM focusing on a Level One (L1) API 580 Risk-Based Inspection training program. The training shall concentrate on process, procedures, modeling, results and optimization. Several equipment items will be presented and the start to finish process demonstrated during the training program. Two additional days shall be utilized to provide a brief introduction to API 510, 570 and 653 Inspection Standards. An additional three days shall be provided to present the benefits, limitations and requirements of utilizing advanced technology including but not limited to: (1) Understanding Guided Wave Ultrasonics; (2) Understanding Acoustic Emission Testing, (3) Understanding In-Service Tank Inspection, and (4) Discussing and presenting solutions addressing the fourteen (14) points the Grantee has presented.

The Grantee, at its discretion, shall have the right to invite third parties to participate in the training. This may include officials from the Ministry of Petroleum and Natural Gas, other government regulatory officials, and officials from other refining companies in India. In order to protect proprietary information of the Contractor, individuals from companies that may offer competitive services and technologies to the Contractor may be invited to attend by the Grantee only with the consent of the Contractor. The Contractor shall have the right to limit the number of participants (class size) in the training, and shall confer with the Grantee regarding the attendance limits to specific courses and demonstrations.

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 3: Pilot Risk-Based Inspection Implementation

The Contractor, in a team effort with personnel to be designated by the Grantee, shall conduct demonstration inspections at the Mumbai refinery that will highlight the advanced technologies and methodologies under consideration by the Grantee. This pilot inspection will take an estimated 30 days to implement. The purpose of the teaming arrangement is to provide the Grantee with a first hand view of new technology applications, implementation techniques, and evaluation criteria for optimizing an asset integrity management program.

The steps in this process shall include:

- Identifying 10 above-ground storage tanks & associated piping
- Collecting necessary survey data on equipment
- Setting up a Risk-Based Inspection (RBI) model for analysis of storage tanks, associated piping and a Fluidized Catalyst Cracking Unit
- Reviewing results of the models and identifying data required to improve model
- Performing conventional inspections required to improve model & assess results
- Identifying advanced technology to be utilized to improve the model
- Performing a cost/benefit analysis and cost justification for utilization of the advanced technology.

The Contractor, in coordination with personnel designated by the Grantee, shall identify the ten (10) above-ground storage tanks following a quick overall analysis of all tanks. Two tanks of immediate concern, two tanks designated as a moderate risk and six tanks considered low risk will be selected for the analysis. The Contractor shall collect all necessary data required to perform an RBI study. Once the available data is identified, the Contractor shall develop a model for each individual tank. The Contractor shall run the models to calculate risk, assess the probability of failure, and the cost to the company if failure occurs. The Contractor shall collect additional data on the tanks to show how additional information may improve modeling capabilities, and how the performance of further advanced testing might reduce risks to individual units at the refinery. The objectives of this task shall include demonstrating the effectiveness of an RBI program in performing cost / benefit analysis, and how such analysis will, in turn, demonstrate the cost advantages of utilizing advanced technologies.

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 4: Advanced Technology Field Demonstrations

The Contractor shall conduct the following field demonstrations of advanced technologies at the Mumbai refinery.

- API 653 External Tank Inspections (Ten Tanks):
 - Settlement Surveys
 - Course Ultrasonic Testing (UT) Thickness Surveys
 - External Floating Roof (EFR) Seal Inspections
 - Visual Inspection
 - Reporting
- API 570 Associated Piping (Ten Tanks):
 - Corrosion Loops
 - Piping and Instrument Diagram (P&ID) Drawings
 - Thickness Measurement Location (TML) identification
 - TML Ultrasonic Testing (UT) Surveys
 - Profiler scans of insulated piping
 - Visual Inspection
 - Reporting
- Acoustic Emission (AE) Testing – (Ten Tanks):
 - Baseline AE Testing on Tanks to
 1. Determine Overall Damage
 2. Categorize A,B,C,D,E
 3. Show Technology
- In-Service Robotics – Two (2) Tanks:
 - Perform In-Service Robotic Testing



- Measure actual wall loss
- Perform EVA (Extreme Value Analysis)
- Show technology
- In-Service Guided Wave Ultrasonic Testing (GWUT) (2,000 Meters):
 - Perform GWUT Set-Up
 - Perform GWUT Testing
 - Prove-Up GWUT Results
 - Perform EVA Analysis
 - Show Technology
- Lixi Profiler (or Alternative) scanning of Insulated In-service Piping
 - Technology Presentation (1 Day)
 - Perform Testing (1 Day)
 - Confirm Results with complimentary NDE technique(s)
- On-Stream Real Time Corrosion Monitoring (2 Installs):
 - Identify Points of Interest
 - Install Chirp UT Systems
 - Set up Communications
 - Present in Real-Time Web System
 - Show Modeling Features

For purposes of implementing Tasks 3 and 4, the Contractor shall import technology and equipment into India necessary to perform the demonstration inspections. At the end of this work, the Contractor shall be permitted to re-export the technology and equipment. The Grantee shall assist the Contractor in securing all Central Government, State Government, and local government permits, and customs privileges necessary to enable the Contractor to import and re-export the technology and equipment on a timely basis. The costs of all such Indian permits, taxes and duties applicable to importing, re-exporting and otherwise utilizing this technology and equipment in this project shall be outside the funds to be provided by USTDA, and shall be the responsibility of the Grantee. The costs of transporting, mobilizing and demobilizing this equipment shall be a cost element within the approved budget for this project.

As in the case of Task 2, the Grantee may invite third parties to participate in the inspection implementation and field demonstrations subject to the same terms and conditions as stated in Task 2 (above).

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 5: Conduct Technical Evaluation

The Contractor shall utilize results from the above visual inspections and advanced testing to perform the following analyses:

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- Update/optimize model to show real risk
- Calculate next inspection intervals
- Calculate next maintenance intervals
- Determine overall maintenance requirements

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 6: Preliminary Environmental Impact Assessment

The Contractor shall assess the environmental impact of applying advanced technologies and methodologies for refinery inspection. This impact analysis shall take into account the costs/benefits of the Project relative to the risks in such areas as release of toxic and other environmentally damaging substances into the air, ground and water due to leaks, accidents, and other unanticipated events.

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 7: Development Impact Assessment

The Contractor shall provide an assessment of the potential development impact of the project. Specific areas to be addressed shall be:

Infrastructure

- Contractor shall summarize how the recommended investments will result in improvements to refinery throughput, security of petroleum product supply, and integrity of the refinery and associated infrastructure.

Human Capacity Building

- Contractor shall summarize the incremental additional local employment and skill development that will be generated as a result of the application of an asset integrity management program at the Mumbai and Vishakhapatnam refineries.

Productivity and Technology Transfer

- Contractor shall identify the new technologies being provided to the project and note any specific "technology transfer" which has occurred by virtue of this project.
- Contractor shall provide an estimate of the productivity gains and safety improvements in the refineries through the implementation of improved technology and methodologies for refinery inspection.

The Contractor shall summarize any benefits identified in the area of **Market-Oriented Reform** or other developmental benefits of the project.

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 8: Prepare Cost Estimates and Economic Assessment

The Contractor shall prepare an estimate of the investment required by the Grantee to obtain the technologies needed to implement a long-term comprehensive asset integrity management program through equipment acquisitions and/or turnkey contracting.

This assessment shall take into account internal manpower requirements, training, equipment and other costs associated with establishing and maintaining an asset integrity management program. The Contractor shall not be required to estimate long-term costs of applying remedial measures recommended by the future inspections.

The purpose of this task is to provide the Grantee with cost guidelines for project implementation. However, decisions on equipment acquisitions and/or turnkey contracting shall be at the sole discretion of the Grantee, and procurement recommendations in the Contractor report will not be binding on the Grantee.

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 9: Equipment and Technology Suppliers

The Contractor shall prepare a list of reputed U.S. firms that are potential suppliers of the equipment, technologies, and services recommended in this study. This list shall include the names and addresses of the firms, as well as key contact information.

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 10: Training Program Recommendations

The Contractor shall recommend immediate and long-term training programs for application by the Grantee for its personnel covering the various facets of asset integrity management for the petroleum refining sector. The training program recommended shall include classroom courses, field demonstrations, orientation visits and other activities in conformity with those supported or endorsed by leading industry organizations such as API, the National Petroleum Refiners Association (NPRA), the Pipeline Research Council International (PRCI), and the American Society of Mechanical Engineers (ASME).

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.



TASK 11: Final Report

The Contractor shall prepare a **Draft Final Report** for the Grantee. Five copies of this draft report shall be submitted to the Grantee upon completion. Contractor shall make a Power Point type presentation of the Draft Final Report to Grantee at Grantee's offices in India. The Grantee shall provide written comments to Contractor within two weeks of Contractor's presentation. The Contractor shall make the necessary changes and modifications to the Draft Final Report.

The Contractor shall prepare and deliver to the Grantee and USTDA a substantive and comprehensive final report of all work performed under these Terms of Reference ("**Final Report**"). The Final Report shall be organized according to the above tasks, and shall include all deliverables and documents that have been provided to the Grantee. The Final Report shall be prepared in accordance with Clause I of Annex II of the Grant Agreement, and shall include an Executive Summary.

The Contractor shall provide the Grantee with 10 printed copies of the Final Report. The Contractor shall provide the Grantee with 6 copies of the Final Report on CD-ROM. The CD-ROM version of the Final Report shall include:

- Adobe Acrobat readable copies of all documents;
- Source files for all drawings in AutoCAD or Visio format; and
- Source files for all documents in MS Office 2000 or later format

Notes:

- (1) **The Contractor is responsible for compliance with U.S. export licensing requirements, if applicable, in the performance of the Terms of Reference.**
- (2) **The Contractor and the Grantee shall be careful to ensure that the public version of the Final Report contains no security or confidential information.**
- (3) **USTDA shall have an irrevocable, worldwide, royalty-free, non-exclusive right to use and distribute the public version of the Final Report, which contains no security or confidential information.**



Annex II

USTDA Mandatory Contract Clauses

A. USTDA Mandatory Clauses Controlling

The parties to this contract acknowledge that this contract is funded in whole or in part by the U.S. Trade and Development Agency ("USTDA") under the Grant Agreement between the Government of the United States of America acting through USTDA and Hindustan Petroleum Corporation Limited ("Client"), dated _____ ("Grant Agreement"). The Client has selected _____ ("Contractor") to perform the feasibility study ("Study") for the Asset Integrity Management project ("Project") in India ("Host Country"). Notwithstanding any other provisions of this contract, the following USTDA mandatory contract clauses shall govern. All subcontracts entered into by Contractor funded or partially funded with USTDA Grant funds shall include these USTDA mandatory contract clauses, except for clauses B(1), G, H, I, and J. In addition, in the event of any inconsistency between the Grant Agreement and any contract or subcontract thereunder, the Grant Agreement shall be controlling.

B. USTDA as Financier

(1) USTDA Approval of Contract

All contracts funded under the Grant Agreement, and any amendments thereto, including assignments and changes in the Terms of Reference, must be approved by USTDA in writing in order to be effective with respect to the expenditure of USTDA Grant funds. USTDA will not authorize the disbursement of USTDA Grant funds until the contract has been formally approved by USTDA or until the contract conforms to modifications required by USTDA during the contract review process.

(2) USTDA Not a Party to the Contract

It is understood by the parties that USTDA has reserved certain rights such as, but not limited to, the right to approve the terms of this contract and amendments thereto, including assignments, the selection of all contractors, the Terms of Reference, the Final Report, and any and all documents related to any contract funded under the Grant Agreement. The parties hereto further understand and agree that USTDA, in reserving any or all of the foregoing approval rights, has acted solely as a financing entity to assure the proper use of United States Government funds, and that any decision by USTDA to exercise or refrain from exercising these approval rights shall be made as a financier in the course of financing the Study and shall not be construed as making USTDA a party to the contract. The parties hereto understand and agree that USTDA may, from time to time, exercise the foregoing approval rights, or discuss matters related to these rights and the Project with the parties to the contract or any subcontract, jointly or separately, without thereby incurring any responsibility or liability to such parties. Any approval or failure to approve by USTDA shall not

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bar the Client or USTDA from asserting any right they might have against the Contractor, or relieve the Contractor of any liability which the Contractor might otherwise have to the Client or USTDA.

C. Nationality, Source and Origin

Except as USTDA may otherwise agree, the following provisions shall govern the delivery of goods and services funded by USTDA under the Grant Agreement: (a) for professional services, the Contractor must be either a U.S. firm or U.S. individual; (b) the Contractor may use U.S. subcontractors without limitation, but the use of subcontractors from Host Country may not exceed twenty percent (20%) of the USTDA Grant amount and may only be used for specific services from the Terms of Reference identified in the subcontract; (c) employees of U.S. Contractor or U.S. subcontractor firms responsible for professional services shall be U.S. citizens or non-U.S. citizens lawfully admitted for permanent residence in the U.S.; (d) goods purchased for performance of the Study and associated delivery services (e.g., international transportation and insurance) must have their nationality, source and origin in the United States; and (e) goods and services incidental to Study support (e.g., local lodging, food, and transportation) in Host Country are not subject to the above restrictions. USTDA will make available further details concerning these provisions upon request.

D. Recordkeeping and Audit

The Contractor and subcontractors funded under the Grant Agreement shall maintain, in accordance with generally accepted accounting procedures, books, records, and other documents, sufficient to reflect properly all transactions under or in connection with the contract. These books, records, and other documents shall clearly identify and track the use and expenditure of USTDA funds, separately from other funding sources. Such books, records, and documents shall be maintained during the contract term and for a period of three (3) years after final disbursement by USTDA. The Contractor and subcontractors shall afford USTDA, or its authorized representatives, the opportunity at reasonable times for inspection and audit of such books, records, and other documentation.

E. U.S. Carriers

(1) Air

Transportation by air of persons or property funded under the Grant Agreement shall be on U.S. flag carriers in accordance with the Fly America Act, 49 U.S.C. 40118, to the extent service by such carriers is available, as provided under applicable U.S. Government regulations.

(2) Marine

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Transportation by sea of property funded under the Grant Agreement shall be on U.S. carriers in accordance with U.S. cargo preference law.

F. Workman's Compensation Insurance

The Contractor shall provide adequate Workman's Compensation Insurance coverage for work performed under this Contract.

G. Reporting Requirements

The Contractor shall advise USTDA by letter as to the status of the Project on March 1st annually for a period of two (2) years after completion of the Study. In addition, if at any time the Contractor receives follow-on work from the Client, the Contractor shall so notify USTDA and designate the Contractor's contact point including name, telephone, and fax number. Since this information may be made publicly available by USTDA, any information which is confidential shall be designated as such by the Contractor and provided separately to USTDA. USTDA will maintain the confidentiality of such information in accordance with applicable law.

H. Disbursement Procedures

(1) USTDA Approval of Contract

Disbursement of Grant funds will be made only after USTDA approval of this contract. To make this review in a timely fashion, USTDA must receive from either the Client or the Contractor a photocopy of an English language version of a signed contract or a final negotiated draft version to the attention of the General Counsel's office at USTDA's address listed in Clause M below.

(2) Payment Schedule Requirements

A payment schedule for disbursement of Grant funds to the Contractor shall be included in this Contract. Such payment schedule must conform to the following USTDA requirements: (1) up to twenty percent (20%) of the total USTDA Grant amount may be used as an advance payment; (2) all other payments, with the exception of the final payment, shall be based upon contract performance milestones; and (3) the final payment may be no less than fifteen percent (15%) of the total USTDA Grant amount, payable upon receipt by USTDA of an approved Final Report in accordance with the specifications and quantities set forth in Clause I below. Invoicing procedures for all payments are described below.

(3) Contractor Invoice Requirements

USTDA will make all disbursements of USTDA Grant funds directly to the Contractor. The Contractor must provide USTDA with an ACH Vendor Enrollment Form (available from USTDA) with the first invoice. The Client shall request disbursement of funds by

USTDA to the Contractor for performance of the contract by submitting the following to USTDA:

(a) Contractor's Invoice

The Contractor's invoice shall include reference to an item listed in the Contract payment schedule, the requested payment amount, and an appropriate certification by the Contractor, as follows:

(i) For an advance payment (if any):

"As a condition for this advance payment, which is an advance against future Study costs, the Contractor certifies that it will perform all work in accordance with the terms of its Contract with the Client. To the extent that the Contractor does not comply with the terms and conditions of the Contract, including the USTDA mandatory provisions contained therein, it will, upon USTDA's request, make an appropriate refund to USTDA. "

(ii) For contract performance milestone payments:

"The Contractor has performed the work described in this invoice in accordance with the terms of its contract with the Client and is entitled to payment thereunder. To the extent the Contractor has not complied with the terms and conditions of the Contract, including the USTDA mandatory provisions contained therein, it will, upon USTDA's request, make an appropriate refund to USTDA."

(iii) For final payment:

"The Contractor has performed the work described in this invoice in accordance with the terms of its contract with the Client and is entitled to payment thereunder. Specifically, the Contractor has submitted the Final Report to the Client, as required by the Contract, and received the Client's approval of the Final Report. To the extent the Contractor has not complied with the terms and conditions of the Contract, including the USTDA mandatory provisions contained therein, it will, upon USTDA's request, make an appropriate refund to USTDA."

(b) Client's Approval of the Contractor's Invoice

(i) The invoice for an advance payment must be approved in writing by the Client.

(ii) For contract performance milestone payments, the following certification by the Client must be provided on the invoice or separately:

"The services for which disbursement is requested by the Contractor have been performed satisfactorily, in accordance with applicable Contract provisions and the terms and conditions of the USTDA Grant Agreement."



(iii) For final payment, the following certification by the Client must be provided on the invoice or separately:

"The services for which disbursement is requested by the Contractor have been performed satisfactorily, in accordance with applicable Contract provisions and terms and conditions of the USTDA Grant Agreement. The Final Report submitted by the Contractor has been reviewed and approved by the Client. "

(c) USTDA Address for Disbursement Requests

Requests for disbursement shall be submitted by courier or mail to the attention of the Finance Department at USTDA's address listed in Clause M below.

(4) Termination

In the event that the Contract is terminated prior to completion, the Contractor will be eligible, subject to USTDA approval, for reasonable and documented costs which have been incurred in performing the Terms of Reference prior to termination, as well as reasonable wind down expenses. Reimbursement for such costs shall not exceed the total amount of undisbursed Grant funds. Likewise, in the event of such termination, USTDA is entitled to receive from the Contractor all USTDA Grant funds previously disbursed to the Contractor (including but not limited to advance payments) which exceed the reasonable and documented costs incurred in performing the Terms of Reference prior to termination.

I. USTDA Final Report

(1) Definition

"Final Report" shall mean the Final Report described in the attached Annex I Terms of Reference or, if no such "Final Report" is described therein, "Final Report" shall mean a substantive and comprehensive report of work performed in accordance with the attached Annex I Terms of Reference, including any documents delivered to the Client.

(2) Final Report Submission Requirements

The Contractor shall provide the following to USTDA:

- (a) One (1) complete version of the Final Report for USTDA's records. This version shall have been approved by the Client in writing and must be in the English language. It is the responsibility of the Contractor to ensure that confidential information, if any, contained in this version be clearly marked. USTDA will maintain the confidentiality of such information in accordance with applicable law.



and

(b) One (1) copy of the Final Report suitable for public distribution ("Public Version"). The Public Version shall have been approved by the Client in writing and must be in the English language. As this version will be available for public distribution, it must not contain any confidential information. If the report in (a) above contains no confidential information, it may be used as the Public Version. In any event, the Public Version must be informative and contain sufficient Project detail to be useful to prospective equipment and service providers.

and

(c) Two (2) CD-ROMs, each containing a complete copy of the Public Version of the Final Report. The electronic files on the CD-ROMs shall be submitted in a commonly accessible read-only format. As these CD-ROMs will be available for public distribution, they must not contain any confidential information. It is the responsibility of the Contractor to ensure that no confidential information is contained on the CD-ROMs.

The Contractor shall also provide one (1) copy of the Public Version of the Final Report to the Foreign Commercial Service Officer or the Economic Section of the U.S. Embassy in Host Country for informational purposes.

(3) Final Report Presentation

All Final Reports submitted to USTDA must be paginated and include the following:

(a) The front cover of every Final Report shall contain the name of the Client, the name of the Contractor who prepared the report, a report title, USTDA's logo, USTDA's mailing and delivery addresses. If the complete version of the Final Report contains confidential information, the Contractor shall be responsible for labeling the front cover of that version of the Final Report with the term "Confidential Version." The Contractor shall be responsible for labeling the front cover of the Public Version of the Final Report with the term "Public Version." The front cover of every Final Report shall also contain the following disclaimer:

"This report was funded by the U.S. Trade and Development Agency (USTDA), an agency of the U. S. Government. The opinions, findings, conclusions or recommendations expressed in this document are those of the author(s) and do not necessarily represent the official position or policies of USTDA. USTDA makes no representation about, nor does it accept responsibility for, the accuracy or completeness of the information contained in this report."

(b) The inside front cover of every Final Report shall contain USTDA's logo, USTDA's mailing and delivery addresses, and USTDA's mission statement.

Camera-ready copy of USTDA Final Report specifications will be available from USTDA upon request.

(c) The Contractor shall affix to the front of the CD-ROM a label identifying the Host Country, USTDA Activity Number, the name of the Client, the name of the Contractor who prepared the report, a report title, and the following language:

“The Contractor certifies that this CD-ROM contains the Public Version of the Final Report and that all contents are suitable for public distribution.”

(d) The Contractor and any subcontractors that perform work pursuant to the Grant Agreement must be clearly identified in the Final Report. Business name, point of contact, address, telephone and fax numbers shall be included for Contractor and each subcontractor.

(e) The Final Report, while aiming at optimum specifications and characteristics for the Project, shall identify the availability of prospective U.S. sources of supply. Business name, point of contact, address, telephone and fax numbers shall be included for each commercial source.

(f) The Final Report shall be accompanied by a letter or other notation by the Client which states that the Client approves the Final Report. A certification by the Client to this effect provided on or with the invoice for final payment will meet this requirement.

J. Modifications

All changes, modifications, assignments or amendments to this contract, including the appendices, shall be made only by written agreement by the parties hereto, subject to written USTDA approval.

K. Study Schedule

(1) Study Completion Date

The completion date for the Study, which is December 31, 2008, is the date by which the parties estimate that the Study will have been completed.



(2) Time Limitation on Disbursement of USTDA Grant Funds

Except as USTDA may otherwise agree, (a) no USTDA funds may be disbursed under this contract for goods and services which are provided prior to the Effective Date of the Grant Agreement; and (b) all funds made available under the Grant Agreement must be disbursed within four (4) years from the Effective Date of the Grant Agreement.

L. Business Practices

The Contractor agrees not to pay, promise to pay, or authorize the payment of any money or anything of value, directly or indirectly, to any person (whether a governmental official or private individual) for the purpose of illegally or improperly inducing anyone to take any action favorable to any party in connection with the Study. The Client agrees not to receive any such payment. The Contractor and the Client agree that each will require that any agent or representative hired to represent them in connection with the Study will comply with this paragraph and all laws which apply to activities and obligations of each party under this Contract, including but not limited to those laws and obligations dealing with improper payments as described above.

M. USTDA Address and Fiscal Data

Any communication with USTDA regarding this Contract shall be sent to the following address and include the fiscal data listed below:

U.S. Trade and Development Agency
1000 Wilson Boulevard, Suite 1600
Arlington, Virginia 22209-3901
USA

Phone: (703) 875-4357
Fax: (703) 875-4009

Fiscal Data:

Appropriation No.: 118/91001
Activity No.: 2008-31018A
Reservation No.: 2008310026
Grant No.: GH2008310004

N. Definitions

All capitalized terms not otherwise defined herein shall have the meaning set forth in the Grant Agreement.

O. Taxes

USTDA funds provided under the Grant Agreement shall not be used to pay any taxes, tariffs, duties, fees or other levies imposed under laws in effect in Host Country. Neither the Client nor the Contractor will seek reimbursement from USTDA for such taxes, tariffs, duties, fees or other levies.



ANNEX 5

TERMS OF REFERENCE

Introduction

The Grantee, a public sector corporation under India's Ministry of Petroleum and Natural Gas, has a requirement for technical assistance and training for an Asset Integrity Management (AIM) program to be applied at its two wholly owned coastal refineries and associated pipelines and facilities in Mumbai and Vishakhapatnam. The Grantee is seeking to upgrade its programs for refinery and pipeline inspection in conformity with continually improving best practices in the international petroleum industry, and in accordance with codes and standards set by the Government of India.

The intention of this work is to: (1) assess the prevailing inspection systems and techniques now undertaken by the Grantee for asset integrity management; (2) recommend improvements with respect to systems and procedures; (3) recommend new inspection methodologies and technologies that will enhance the safety and the integrity of petroleum refining operations, and will better ensure the reliability of meeting its petroleum products supply obligations to the Indian market; and (4) demonstrate some of these advanced technologies.

Within the context of formulating an asset integrity management program utilizing modern state-of-the-art methodologies and technologies, the Grantee has identified several specific areas of possible inquiry within the refineries, including:

1. Non-destructive technology (NDT) and procedures to assess the condition of insulated piping without the removal of insulation.
2. NDT / procedures for internal inspection of a 38 inch diameter jetty water line to assess the condition of the cement lining.
3. Real-time on-stream monitoring of critical pipelines and components carrying high-sulfur crude or highly corrosive products using ultrasonic monitoring.
4. Inspecting the condition of insulated columns without removing the insulation.
5. Complete internal / external inspection of studded convection tubes and boiler tubes.
6. Comprehensive inspection of reformer tubes with the help of multi-probe crawler / laser technique.
7. Assessing the condition of underground lines having bends without excavating the lines.
8. In-situ and laboratory techniques for assessing remaining life of furnace tubes, reactor - regenerator refractory lining, equipment operating in creep zones, etc.

9. Reliable condition assessment of bottom plates and shell for aboveground storage tanks including the application of new robotic inspection technologies.
10. Inspection of insulated tanks without the removal of insulation.
11. Integrity assessment of residual catalytic cracking (RCC) structures.
12. On-stream inspection of tower internals for purposes of ascertaining tray dislodgement, etc.
13. Substitute (alternative materials) for cement lining in salt water and rubber lined pipes for improved corrosion protection.
14. Reliability assessment techniques for super duplex stainless steel tubes in coolers.

The AIM study shall evaluate the current status of the Grantee's inspection programs and plans, and recommend and demonstrate the use of advanced industry standard practices and technologies in selected areas. This work effort shall include a level one (L1) hands-on training program using the American Petroleum Institute (API) 580 Recommended Practice and will highlight the resulting cost/benefits when utilizing advanced technology to improve reliability, safety, environmental control and refining throughput.

The API 580 Recommended Practice and associated modeling software are the basis for all AIM, as they provide the modeling requirements to understand, demonstrate, optimize and present the probabilities of failure and overall risk with each equipment item. Optimizing the model utilizing industry inspection practices and advanced technology to improve the probability of identifying failure mechanisms reduces the overall level of error within the model.

Three individual inspection standards exist which support this risk-based inspection (RBI) program. These standards include API 570 (Recommended Practice to Visually Inspect Associated Piping), API 510 (Recommended Practice to Visually Inspect Vessels) and API 653 (Recommended Practice to Visually Inspect Above-Ground Storage Tanks). The technology demonstration and training shall utilize the risk-based inspection program along with the above three inspection standards to demonstrate a process, procedure, methodology and resulting benefit of modeling risk.

Advanced technologies that are employed above and beyond visual inspection or that are utilized while the asset remains "in-service" shall be presented as part of the technical assistance. Emphasis will be on the fourteen (14) individual issues the Grantee has presented as areas of concern and interest mentioned above. At the same time several techniques which can feasibly be demonstrated during this study shall be offered. The results from these advanced inspection technologies shall employ the API 580 Risk-Based Inspection model to show: (1) how advanced technology improves the understanding of risk and probability of failure; (2) how application of new technology can increase the interval between inspections to result in less operations downtime, increased refining throughput, and reduced cost; (3) how to assure unplanned outages do

not occur causing significant reductions in petroleum product supply availability to the domestic market and financial loss to the company; (4) how new technology improves the understanding of mechanical conditions that enable the operator to more efficiently plan maintenance activities during planned outages; and (5) how risk-based inspection will allow the operator to optimize and properly manage the refineries and avoid accidents and other unanticipated service disruptions that may include loss of life and environmental damage.

Scope-Of-Work

TASK 1: Initial Site Meeting and Survey

The Contractor team members shall travel to Mumbai, India to initiate work for the Grantee. The Grantee and the Contractor shall have a project kick-off meeting to address in-country work tasks, work schedules, and logistics.

The Contractor shall visit the Mumbai and Visakhapatnam refineries for a preliminary site survey, and to collect necessary data for the TA. The Contractor shall meet with senior refinery operations, maintenance, and inspection officials to discuss current inspection programs being carried out at the two refineries.

Deliverables: The Contractor shall submit to the Grantee a brief **Inception Report** at the conclusion of Task 1. This report will briefly outline Contractor's work plan, consistent with these Terms of Reference, and any outstanding issues pertaining to logistics for the project.

Throughout the course of this TA, the Contractor shall submit brief **Monthly Reports** to the Grantee that will identify the progress of work, and any impediments to work that will affect the time schedule for completion of the TA. Communication between the Contractor and the Grantee on this matter is essential.

TASK 2: Training Program

The Contractor shall conduct a one-week training program for Grantee officials at the Mumbai facilities of the Grantee (at the headquarters or refinery as determined by the Grantee). This training program shall consist of the following courses:

- d. Introduction to AIM
- e. Risk-Based Inspection (API 580) Level I Training
- f. Analysis and Solutions to the Grantee's 14 Points of Concern/Interest

The training courses shall introduce AIM focusing on a Level One (L1) API 580 Risk-Based Inspection training program. The training shall concentrate on process, procedures, modeling, results and optimization. Several equipment items will be presented and the start to finish process demonstrated during the training program. Two additional days shall be utilized to provide a brief introduction to API 510, 570 and 653 Inspection Standards. An additional three days shall be provided to present the benefits,

limitations and requirements of utilizing advanced technology including but not limited to: (1) Understanding Guided Wave Ultrasonics; (2) Understanding Acoustic Emission Testing, (3) Understanding In-Service Tank Inspection, and (4) Discussing and presenting solutions addressing the fourteen (14) points the Grantee has presented.

The Grantee, at its discretion, shall have the right to invite third parties to participate in the training. This may include officials from the Ministry of Petroleum and Natural Gas, other government regulatory officials, and officials from other refining companies in India. In order to protect proprietary information of the Contractor, individuals from companies that may offer competitive services and technologies to the Contractor may be invited to attend by the Grantee only with the consent of the Contractor. The Contractor shall have the right to limit the number of participants (class size) in the training, and shall confer with the Grantee regarding the attendance limits to specific courses and demonstrations.

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 3: Pilot Risk-Based Inspection Implementation

The Contractor, in a team effort with personnel to be designated by the Grantee, shall conduct demonstration inspections at the Mumbai refinery that will highlight the advanced technologies and methodologies under consideration by the Grantee. This pilot inspection will take an estimated 30 days to implement. The purpose of the teaming arrangement is to provide the Grantee with a first hand view of new technology applications, implementation techniques, and evaluation criteria for optimizing an asset integrity management program.

The steps in this process shall include:

- Identifying 10 above-ground storage tanks & associated piping
- Collecting necessary survey data on equipment
- Setting up a Risk-Based Inspection (RBI) model for analysis of storage tanks, associated piping and a Fluidized Catalyst Cracking Unit
- Reviewing results of the models and identifying data required to improve model
- Performing conventional inspections required to improve model & assess results
- Identifying advanced technology to be utilized to improve the model
- Performing a cost/benefit analysis and cost justification for utilization of the advanced technology.

The Contractor, in coordination with personnel designated by the Grantee, shall identify the ten (10) above-ground storage tanks following a quick overall analysis of all tanks. Two tanks of immediate concern, two tanks designated as a moderate risk and six tanks considered low risk will be selected for the analysis. The Contractor shall collect all necessary data required to perform an RBI study. Once the available data is identified, the Contractor shall develop a model for each individual tank. The Contractor shall run

the models to calculate risk, assess the probability of failure, and the cost to the company if failure occurs. The Contractor shall collect additional data on the tanks to show how additional information may improve modeling capabilities, and how the performance of further advanced testing might reduce risks to individual units at the refinery. The objectives of this task shall include demonstrating the effectiveness of an RBI program in performing cost / benefit analysis, and how such analysis will, in turn, demonstrate the cost advantages of utilizing advanced technologies.

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 4: Advanced Technology Field Demonstrations

The Contractor shall conduct the following field demonstrations of advanced technologies at the Mumbai refinery.

- API 653 External Tank Inspections (Ten Tanks):
 - Settlement Surveys
 - Course Ultrasonic Testing (UT) Thickness Surveys
 - External Floating Roof (EFR) Seal Inspections
 - Visual Inspection
 - Reporting

- API 570 Associated Piping (Ten Tanks):
 - Corrosion Loops
 - Piping and Instrument Diagram (P&ID) Drawings
 - Thickness Measurement Location (TML) identification
 - TML Ultrasonic Testing (UT) Surveys
 - Profiler scans of insulated piping
 - Visual Inspection
 - Reporting

- Acoustic Emission (AE) Testing – (Ten Tanks):
 - Baseline AE Testing on Tanks to
 1. Determine Overall Damage
 2. Categorize A,B,C,D,E
 3. Show Technology

- In-Service Robotics – Two (2) Tanks:
 - Perform In-Service Robotic Testing
 - Measure actual wall loss
 - Perform EVA (Extreme Value Analysis)
 - Show technology

- In-Service Guided Wave Ultrasonic Testing (GWUT) (2,000 Meters):
 - Perform GWUT Set-Up

- Perform GWUT Testing
- Prove-Up GWUT Results
- Perform EVA Analysis
- Show Technology
- Lixi Profiler (or Alternative) scanning of Insulated In-service Piping
 - Technology Presentation (1 Day)
 - Perform Testing (1 Day)
 - Confirm Results with complimentary NDE technique(s)
- On-Stream Real Time Corrosion Monitoring (2 Installs):
 - Identify Points of Interest
 - Install Chirp UT Systems
 - Set up Communications
 - Present in Real-Time Web System
 - Show Modeling Features

For purposes of implementing Tasks 3 and 4, the Contractor shall import technology and equipment into India necessary to perform the demonstration inspections. At the end of this work, the Contractor shall be permitted to re-export the technology and equipment. The Grantee shall assist the Contractor in securing all Central Government, State Government, and local government permits, and customs privileges necessary to enable the Contractor to import and re-export the technology and equipment on a timely basis. The costs of all such Indian permits, taxes and duties applicable to importing, re-exporting and otherwise utilizing this technology and equipment in this project shall be outside the funds to be provided by USTDA, and shall be the responsibility of the Grantee. The costs of transporting, mobilizing and demobilizing this equipment shall be a cost element within the approved budget for this project.

As in the case of Task 2, the Grantee may invite third parties to participate in the inspection implementation and field demonstrations subject to the same terms and conditions as stated in Task 2 (above).

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 5: Conduct Technical Evaluation

The Contractor shall utilize results from the above visual inspections and advanced testing to perform the following analyses:

- Update/optimize model to show real risk
- Calculate next inspection intervals
- Calculate next maintenance intervals
- Determine overall maintenance requirements

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 6: Preliminary Environmental Impact Assessment

The Contractor shall assess the environmental impact of applying advanced technologies and methodologies for refinery inspection. This impact analysis shall take into account the costs/benefits of the Project relative to the risks in such areas as release of toxic and other environmentally damaging substances into the air, ground and water due to leaks, accidents, and other unanticipated events.

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 7: Development Impact Assessment

The Contractor shall provide an assessment of the potential development impact of the project. Specific areas to be addressed shall be:

Infrastructure

- Contractor shall summarize how the recommended investments will result in improvements to refinery throughput, security of petroleum product supply, and integrity of the refinery and associated infrastructure.

Human Capacity Building

- Contractor shall summarize the incremental additional local employment and skill development that will be generated as a result of the application of an asset integrity management program at the Mumbai and Vishakhapatnam refineries.

Productivity and Technology Transfer

- Contractor shall identify the new technologies being provided to the project and note any specific “technology transfer” which has occurred by virtue of this project.
- Contractor shall provide an estimate of the productivity gains and safety improvements in the refineries through the implementation of improved technology and methodologies for refinery inspection.

The Contractor shall summarize any benefits identified in the area of **Market-Oriented Reform** or other developmental benefits of the project.

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 8: Prepare Cost Estimates and Economic Assessment

The Contractor shall prepare an estimate of the investment required by the Grantee to obtain the technologies needed to implement a long-term comprehensive asset integrity management program through equipment acquisitions and/or turnkey contracting.

This assessment shall take into account internal manpower requirements, training, equipment and other costs associated with establishing and maintaining an asset integrity management program. The Contractor shall not be required to estimate long-term costs of applying remedial measures recommended by the future inspections.

The purpose of this task is to provide the Grantee with cost guidelines for project implementation. However, decisions on equipment acquisitions and/or turnkey contracting shall be at the sole discretion of the Grantee, and procurement recommendations in the Contractor report will not be binding on the Grantee.

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 9: Equipment and Technology Suppliers

The Contractor shall prepare a list of reputed U.S. firms that are potential suppliers of the equipment, technologies, and services recommended in this study. This list shall include the names and addresses of the firms, as well as key contact information.

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 10: Training Program Recommendations

The Contractor shall recommend immediate and long-term training programs for application by the Grantee for its personnel covering the various facets of asset integrity management for the petroleum refining sector. The training program recommended shall include classroom courses, field demonstrations, orientation visits and other activities in conformity with those supported or endorsed by leading industry organizations such as API, the National Petroleum Refiners Association (NPRA), the Pipeline Research Council International (PRCI), and the American Society of Mechanical Engineers (ASME).

Deliverable: The Contractor shall submit brief **Monthly Reports** to the Grantee, as required.

TASK 11: Final Report

The Contractor shall prepare a **Draft Final Report** for the Grantee. Five copies of this draft report shall be submitted to the Grantee upon completion. Contractor shall make a Power Point type presentation of the Draft Final Report to Grantee at Grantee's offices in India. The Grantee shall provide written comments to Contractor within two weeks of

Contractor's presentation. The Contractor shall make the necessary changes and modifications to the Draft Final Report.

The Contractor shall prepare and deliver to the Grantee and USTDA a substantive and comprehensive final report of all work performed under these Terms of Reference ("**Final Report**"). The Final Report shall be organized according to the above tasks, and shall include all deliverables and documents that have been provided to the Grantee. The Final Report shall be prepared in accordance with Clause I of Annex II of the Grant Agreement, and shall include an Executive Summary.

The Contractor shall provide the Grantee with 10 printed copies of the Final Report. The Contractor shall provide the Grantee with 6 copies of the Final Report on CD-ROM. The CD-ROM version of the Final Report shall include:

- Adobe Acrobat readable copies of all documents;
- Source files for all drawings in AutoCAD or Visio format; and
- Source files for all documents in MS Office 2000 or later format

Notes:

- (4) **The Contractor is responsible for compliance with U.S. export licensing requirements, if applicable, in the performance of the Terms of Reference.**
- (5) **The Contractor and the Grantee shall be careful to ensure that the public version of the Final Report contains no security or confidential information.**
- (6) **USTDA shall have an irrevocable, worldwide, royalty-free, non-exclusive right to use and distribute the public version of the Final Report, which contains no security or confidential information.**