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### **Project Insurance involving Second Hand Plant and Machinery**



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## **1.0 Executive Summary:**

It is appreciated that the traditional approach taken by global Construction and Engineering insurance markets has been to exclude testing and commissioning on second hand machinery and equipment. Through the contributions made in this IMIA paper, it is not seen as the objective of the group to recommend that insurers seek to provide unqualified cover on such items given the increased inherent hazards involved. However, it is viewed as the group's purpose to provide guidance on the key issues involved and in particular: those technical features underpinning the risk assessment process; debate practical approaches to the provision of policy cover which are already in use in the commercial insurance environment; the inclusion of loss examples, an overview of which attempts to provide some 'lessons learned'.

The appendices contain a summary of those relevant features associated with the risk appraisal process, an overview of independent reports that have been prepared on actual construction projects commenting on requirements to bring individual units in line with 'fit for purpose' and provide analysis of individual units and aspects that need to be considered when considering the insurance of second hand plant and machinery. There are core issues which are common to all risks involving the insurance of construction projects. However, in this paper every attempt has been made to include and highlight issues which differentiate risk assessment and the provision of tailored insurance cover when dealing with construction risks involving second hand plant and machinery.

## **2.0 Introduction:**

From a 'definition' perspective, 'second hand' can be interpreted in a number of different ways. Whilst the term can be defined as 'taken on another's authority', the most appropriate definition to be used and particularly where second hand machinery and equipment is involved would be either 'not new' or 'owned by someone else before'. Unfavourable economic conditions, difficult trading environments and a lack of business confidence in future earning streams may encourage operators to invest in second hand plant and machinery. The prospect of financial restrictions may limit the Insured's ability to raise additional capital to fund new equipment for incorporation into the construction project, leading to the need to explore other more cost effective and competitive options. Whilst recessionary impact can be experienced in global terms, specific regions (and especially developing nations) may suffer more acutely than others increasing project risk exposures particularly relative to moral hazard.

In attempting to avoid any prospect of discrediting the integrity of the diligent insured in such situations, some operators may simply choose to legitimately identify second hand plant and machinery for purchase given individual profile, capacity, location and the ability to meet desired quality and quantity needs and requirements. Also, the purchase and re-erection of second-hand machinery and equipment does have the advantage in that this process can encourage 'speed' of project delivery than may be the case when manufacturing and erecting equipment that is brand new. Nevertheless, construction insurers are likely to have been affected by adverse underwriting results as a direct result of accepting distressed risk exposures from insured's who have been experiencing financial difficulties.

The recessionary environment can have a direct and negative impact on the magnitude and frequency of fraudulent acts and particularly those involving arson and theft related incidents. In all such instances, therefore it is recommended that initially a full and detailed assessment be made of the precise reasons as to why the insured has decided to invest in second hand plant and equipment? In addition, it becomes prudent to conduct a detailed examination of the ultimate Operator's financial status, how the project is to be funded and information relative to sustaining required maintenance and inspection spend through the initial operations stages may provide increased confidence.

As far as the insured is concerned, acquiring "second-hand" plant may appear very attractive particularly from a cost perspective but for the insurer naturally there are increased risks. The prudent insurer must make sure that a detailed risk assessment has been conducted to ensure that the plant and equipment for re-erection is in an acceptable condition. Before underwriting construction insurance involving second-hand equipment, the insurer has to have an overview of the project and assess the risk by evaluating the project management features and the inherent project risks. The need to tailor construction insurance cover according to the conclusions drawn from the risk assessment stages becomes paramount.



**Figure 1:**

**A brittle fracture of a gearbox due to over-pressure during oil draining.**

### **3.0 Construction Project Risk Assessment:**

#### **3.1 Project Management Features:**

##### **3.1.1 Previous/Current Ownership:**

An assessment of the integrity of the current owner of the machinery and equipment becomes essential. Within this context it is important to understand the precise reasons as to why the Owner is deciding to sell the plant and this could be attributable to a number of factors. Plant condition, output and efficiency aligned to on-going maintenance and inspection expenditure may no longer make continued operation of the machinery financially viable. Process and territorial considerations may combine such that long term market trends dictate reduced or no demand for the finished products being manufactured for sale.

The need to establish the plant's operational history particularly relative to maintenance and inspection activities becomes important. In addition the detail of any modifications that have been made to the equipment from when it was initially manufactured and supplied is essential. Details of any major failures, forced outages or previous claims incurred leading to the requirement to repair or replace the machinery will provide the underwriter with guidance as to the need for potentially a more in depth line of enquiry in connection with specific critical objects. The precise measures that were taken to prevent a re-occurrence of any historical incidents would provide the necessary comfort levels that the plant has returned to a normal, stable and expected operating condition and environment.

### **3. 1. 2 Owner/Operator Experience:**

Obtaining relevant details of the Principal's operational experience within the industry sector concerned-oil, gas, power generation or specific process industries-becomes an invaluable part of the risk assessment when considering project insurance on second hand plant and machinery. Such detailed information should allow the underwriter to gauge the degree of familiarity and expertise of the Principal relative to the specific industry. On occasions, the Owner/Operator may decide to depart from their 'core' and recognised operations and diversify their business towards other industry segments and markets to stimulate or bolster potential financial returns and therefore may have limited experience with the industry and/or project management disciplines.

In such cases, it becomes particularly important to obtain information relative to how the project is to be managed from a technical perspective, establish the identity and track records of the specific nominated parties to be deployed through the course of the construction project and their industry background and qualifications. A listing of reference projects should be obtained and specifically details of those that have involved the re-erection of machinery and equipment that has been subject to previous operation becomes essential together with the management and contract standards and approach that have been or are to be deployed.

An investigation should also be made into the incident and claims history of the Principal not only in connection with previous construction project activity (and specifically where second hand machinery has been constructed and insured) but also into the 'operational' risk performance. Such details may give the underwriter a broader insight into the quality and integrity of the insurance buyer and intent relative to relevant and appropriate contingency planning in the event of a loss.

### **3. 1. 3 Contractor Management:**

The insurance intended to be provided to support the construction of projects involving second hand plant and equipment do carry a number of bespoke exposures particularly relative to dismantling (handling), transportation, erection and testing and commissioning exposures. As such, it becomes essential to gain a full appreciation of the managing contractor's industry segment expertise, project management history and capabilities and the process associated with the pre-qualification and approval of sub contractors where significant parts of the contract work are to be delegated to other parties.

Authority levels in regard to the degree of management control required as delegated from or agreed in conjunction with the Principal through the execution of the project should also be evaluated given that a significantly high percentage of losses do arise from human error, negligence and faulty workmanship. As such, the experienced contract manager will be fully conversant with potential inherent hazard associated with process technology involving second hand machinery and equipment, unique exposures presented by those critical units to be incorporated within the construction project and the degree to which such risks need to be managed and controlled.

Equally, there becomes a need to appreciate the level of competence of the workforce that will be deployed to complete the project. Inexperienced operatives may have a good working understanding of more 'modern' processes but may have little or no knowledge of the operating characteristics of more 'mature' machinery and equipment, often a feature of the construction of second hand plants. Overall, it becomes necessary to establish the degree of familiarity with both the working environment (erection) and operational methods (testing and commissioning).

### **3. 1. 4 Manufacturers and Suppliers:**

Identifying the manufacturer and the key suppliers of the original equipment becomes particularly important when considering the provision of project insurance for second hand plant and equipment. Such parties usually have a strong association with standard types of specific machinery whether this involves pressure vessels, rotating machinery or electrical equipment and its intended application. Obtaining details of the manufacturer's global status and brand and conducting an assessment of the number of similar units that have been or are in commercial operation can provide the underwriter with an appropriate degree of comfort. Is there a need for other manufacturers to be involved in the case where the original manufacturer is no longer in business and what qualifies them to provide equipment to the required standards for longer term operation?

The integrity of the manufacturer's build quality needs to be considered in order to check general operating reliability and performance reputation. An investigation into the manufacturer's ability (or recognised preferred provider) to provide technical support during the testing and commissioning phases of the project may provide an increasing degree of confidence. In all cases, it becomes prudent to ensure that all contract stages and disciplines are carried out strictly in accordance with the original manufacturer's instructions and recommendations.

Specific information relative to the intent of the manufacturer and main suppliers to provide technical support to the future operational risk post 'practical completion' particularly through the development of formal maintenance, inspection and servicing agreements (LTSA's), would indicate a very positive and sustainable commitment to the success of the venture overall. An assessment as to the scope and depth of services intended to be provided and their relationship to the critical machinery and equipment identified is considered invaluable in the risk appraisal process.

### **3. 1. 5 Contractual Responsibilities and Insurance Provisions:**

As with other construction project type risks, the contract between the Principal/Operator and Contractor, and Contractor and sub contractors can significantly influence the ability to manage and control risk although these assume greater importance when dealing with second hand plant. As noted above is there a pre-qualification process, does the contract have detailed requirements and responsibilities for health, safety and the environment, quality, security, preservation and handover including provision of documentation (for example, equipment data books). For second hand plant projects specifically, is there a protocol to manage situations where plant does not meet the designed specification? Is there a Management of Change formal process? Are these topics included as part of the contracts for each of the principal contract disciplines?

Within this context it should be mandatory to evaluate those processes associated with ownership and the responsibility trails surrounding the supply and purchase of the second hand equipment that is intended to be incorporated within the construction project. This becomes important to establish given the fact that the machinery will or may come into contact with a number of parties all possessing a differing degree of 'insurable interest' across a multitude of project tasks before finally being received by the 'end user'. Naturally, any tailored project insurance programme for the erection of second hand plant and equipment will focus on the prevailing qualifying risks at the contract site. However, it is recognised that most construction policies can be extended to include other related contract disciplines such as project cargo, inland transit, works 'damage and testing' provisions and offsite storage exposures, services that could involve different 'providers' in each case.

By way of example, it is common for 'used' plant and equipment to be placed in the care, custody and control of another 'contractor' given a need and requirement to 'refurbish, revamp and/or modernise' prior to final delivery to the contract site. Details of any formal contract conditions and provisions agreed between the parties outlining the extent of 'responsibility' for the machinery and any specific 'insurance' requirements during the course of the supply of the equipment destined for integration as part of within the construction project as a result should be reviewed. What becomes important is to ensure that all the contractual exposures are considered in drafting and reaching agreement on the final project policy wording.

## **3. 2 Project Process Technology:**

### **3. 2. 1 Introduction:**

A review of the process technology intended to be incorporated within the project becomes necessary. More specifically, an in depth analysis is recommended on all critical items and objects as part of the risk appraisal process. Reference is frequently made to the need for the development and execution of a practical project site survey plan and for the receipt of regular project progress reports which is recommended for any construction project. However, the fundamental discipline that needs to be carried out when assessing the viability of providing construction project insurance on second hand plant and equipment and the extent of the policy cover to be provided, lies with the need to insist on a thorough due diligence inspection of the plant and machinery by a reputable, independent and internationally recognised body.

This organisation and their engineering representatives should work alongside the contractor nominated for the initial dismantling activities as it is more usually only once that discipline has been completed that a proper and detailed inspection of the machinery and equipment which will be the subject of future re-erection elsewhere can be undertaken. This due diligence exercise should include a written report commenting on the condition, integrity and remaining life expectancy of the critical items of plant and equipment and provide a narrative supporting any repair or replacement features that are necessary to ensure that the machinery is in an appropriate condition for future commercial operation as intended.

The importance of the material detail contained within this report cannot be underestimated. In addition to forming the foundation for the risk assessment processes the information may provide crucial evidence in loss adjustment investigations should future project losses be experienced. It is suggested that any diligent buyer of second hand machinery and equipment would request such a report as a matter of routine before the point of purchase without the need for significant encouragement from banks and financial institutions who may be involved in project finance or interested insurers.

### **3. 2. 2 Transportation:**

Most construction policies do make provision for cover for inland transit within the region or territory whether conveyances are intended to be undertaken by road, rail or inland waterway. Second hand plant and equipment offers distinct challenges than those involved in the insurance of brand new items and objects. Machinery that is being supplied as new will usually have been dispatched using established freight forwarders with a proven track in handling the transportation risks and challenges posed by specific items of equipment. In addition, new items will tend to be supplied in their original packaging tailored for appropriate protection and insulation given the mode of transportation selected and the elemental perils to which they may be exposed. In the case of second hand plant, the same standards and safeguards may not exist and additional investigation is required.

As such, there is a need to establish details of the EPC Contractor, freight forwarder and their experience, and certainly with regard to any critical items identified (value, size, weight, dimensions) obtain a more in depth overview of the packing specifications of the suppliers and request a preliminary transportation method statement (particularly in connection with any intended inland river barge transits). In addition, it is important to identify the ports of discharge in relation to the nominated contract site and establish details of the route, terrain and security requirements dependent on the socio-political climate within the territory.

### **3. 2. 3 Identification:**

The overall process and the functions of critical machines within the process may not necessarily be obvious from the name of the manufacturer, brand and unit type and may require further identification given intended use and work application within the construction project.



In the case of the use of second hand machinery and equipment, there is always a need to ensure that the process units being purchased are entirely aligned, are capable of meeting the designated contract specifications and requirements and possess a significant probability of achieving intended quality and quantity demands, i.e. the performance criteria.

Ideally, when conducting relevant risk assessment in this class, it is hoped that the machinery and equipment intended for purchase and re-erection will have been originally procured and supplied by reputable equipment manufacturers supported by the appropriate documentation. However, certain process types and the critical items of machinery intended to be integrated within may be less renowned, have limited previous or current global 'fleet' maturity and reach and possess limited information available relative to the historical record and reliability. In such situations, the process plant can be considered unique presenting increased risks associated with the ability to repair, replace or ensure effective contingency planning for example, the accessing of identical spare parts.

Territorial considerations become vitally important to research. Often 'second hand' plant leaving one region or jurisdiction and destined for another will be subject to different or even more stringent statutory regulations and requirements e.g. health and safety regulations on pressure vessels (boilers) and lifting equipment, PCB's (Polychlorinated biphenyls) impacting transformers. Whilst the implications of obtaining the appropriate and up to date 'local' certification by registered governing inspectorates providing confirmation that the machinery is in sound working order is primarily for reasons of safety, obtaining positive feedback in this area would provide the underwriter with an increasing comfort factor regarding the integrity and condition of the equipment.

### **3. 2. 4 Design, Technology and Obsolescence:**

Given the challenges associated with project insurance involving second hand plant and equipment (and being cognisant of any future intention to provide testing and commissioning cover should this indeed be considered appropriate), it becomes prudent to check that the subject matter intended for cover is of 'standard' type with no prototypical, experimental or untried features prevailing. As a consequence, there is a need to ensure that the plant and equipment and the overall process in its entirety is in fact 'proven' with any planned changes to service, operating conditions (e.g. temperature, pressure etc), including 'scale up' for use at higher throughput/output, and integrity of materials, investigated thoroughly.

In terms of the engineering standards to be applied, it is preferable for the Principal managing the project to have developed their own guidelines and that these are compliant with current international best practice and that such standards will be applied and consistently adhered to during both the re-erection and testing and commissioning phases of the project. In discussing overall 'design' aspects relative to second hand plant and equipment it becomes essential to ensure that control systems are commensurate to both the process and the technology and that there exists a good likelihood that adequate control, interlock and trip by-passes will be in place during the testing and commissioning phases.

The suitability and compatibility of plant and or equipment should have been reviewed as part of the overall project HAZOP (Hazard and Operability) study or other process hazard analysis. However, it is likely that certain process equipment industry best practice has progressed and that the original equipment's critical safety monitoring and operational equipment will need to be upgraded.

The role of the Engineering Contractor becomes critical in this case and there is a need to have a clear high level strategy as to what standard of emergency and operating controls are to be planned for, the suitability and additional actions necessary to achieve successful integration and modernisation, and finally and most importantly, the tests that will validate practical and consistent achievement of design performance.

In addition, there becomes a need to review and check the position relative to fire detection and protection systems and ensure that these are fully aligned and engaged according to the process involved and that these have kept pace with development and technological advancement within the specific industry. Expectation in terms of the minimum standards to be applied in this regard should be compared with established global benchmarks (NFPA), tailored according to relevance and requirement. When consideration is given to the inherent risk associated with second hand plant and equipment in all the areas outlined above, an investigation should be undertaken to the degree of any 'obsolescence' or otherwise. In the event of failure, increased costs may be apparent within repair processes requiring attention through specialist techniques whilst replacement parts may have to be specially made or adapted.

### **3. 2. 5 Age and Condition:**

It is apparent that process items will inevitably deteriorate with age, dependent on operational conditions and the degree to which inspection and maintenance programmes have been designed and executed to protect or enhance working life expectancy. Previous operation and process use involving elevated temperatures and pressures and/or cyclic conditions will have an impact on the condition of the machinery and equipment in terms of remnant life.

Additionally, material science has progressed significantly in recent years to the extent that life expectancy estimates and expected failure mechanisms such as fatigue, creep, stress corrosion cracking and hydrogen embrittlement, specific phenomena within a more general 'wear and tear' and 'gradual deterioration' context have become much better understood. Normally such prevalent premature failure mechanisms may not be limited to that emanating from normal process use but become more associated with the durability of the materials involved given their prior and possible prolonged exposure to harsh physical environments.

Dependent on the contract requirements and profile there is clearly a need to ensure that the level of technical information (for example maintenance records) provided at the outset in conjunction with the ultimate Operator and the Contractors involved is sufficiently detailed to make an informed judgment on the condition of equipment through the course of completing the risk assessment process. In dealing with 'second hand' machinery, it becomes prudent to seek the services of an independent inspection authority to conduct in depth surveys and 'stamp' and 'sign off' the machinery condition-pressure vessels, rotating machinery, electrical equipment-as being suitable to meet the contract demands and expectations.

Whilst every attempt should be made to request details of known problems and pre-existing defects (and the ultimate policy wording should be tailored to reflect this and offer the necessary protection), such action cannot expect to replace ‘first hand’ confirmation that the machinery is in good condition and capable of meeting and sustaining contract and operational requirements through the testing and commissioning phases and into the initial operations period.

### **3. 2. 6 Refurbishment Characteristics: Manufacturers Guarantees**

In addressing the position relative to construction insurance provision for second hand machinery and equipment, there may be a number of unique risk features that exist and combine to significantly alter the original schedule programme thus increasing the prospect of the need for further variation orders and required contract extensions. For example, alterations may be made to the original machinery and equipment specification. In cases where second hand equipment is required to be insured, there remains a high probability that some modification will be required to the original design and configuration of the process plant involved.

The opportunity may be taken to ‘up grade’ the plant to increase productivity and efficiency or seek to ensure appropriate integration with existing process facilities at the site of re-erection. There may be a need to re-assess and re-vamp certain design features for example, in the critical areas associated with fire detection and protection and to reflect potential increases in ‘catastrophe’ exposure (earthquake, windstorm) as dictated by the re-location plans. The planned contract site may have different access, layout and spacing requirements than were evident at the original location and alterations or additional refurbishment work may be required on existing plant at the site of re-erection activities to accommodate the machinery and equipment arriving.

Where second hand machinery and equipment has been subject to refurbishment, the manufacture, supplier and/or contractor involved may have been requested to provide warranties. In such instances, it becomes important to establish the period, scope and terms of such guarantees offered by the contractor. For instance, the cover provided may only be limited to those parts and labour associated with the rectification of the work and plant items involved that were the subject of the refurbishment contract and not extend to cover additional items damaged as a result of their failure.



**Figures 2 and 3: Machinery Breakdown to Generator**

### **3. 2. 7 Prolonged Storage Periods:**

In addition, when dealing with the construction features associated with second hand plants, it is not uncommon for the insured machinery and equipment to be initially dismantled but then left in a prolonged storage environment pending transportation to the intended contract site for re-erection. This situation can arise from a number of factors including the need to specially address civil work or indeed adapt existing machinery and equipment to accommodate the plant and equipment that forms part of the intended 'contract works'.

Nevertheless, in each case there is a need to identify the 'care and maintenance' or preservation plan that is to be developed and executed, by whom and ensure that planned programme is specific to the machinery involved. When confronted with more prolonged periods of storage requirement, it is recommended that interested insurers commission a visit to stores and warehousing not only to check the depth and suitability of the maintenance activities for example temperature/humidity controlled storage for electronic equipment and electric motor winding heaters but also to assess other features such as fire detection, protection and separation.

### **3. 2. 8 Plant Integration:**

Where the contract requirements demand that the supply of second hand plant be integrated with existing equipment already located at the contract site this can lead to a further increase in project risk exposure. From a project management perspective there is clearly a need for both the principal and the managing contractors to have not only a sound technical working knowledge of the 'contract works' but also a thorough understanding of design, specification, material and the process operating conditions of the existing plant.

Obtaining a track record of those responsible contract parties involved given their industry expertise, their ability to conduct the work professionally within budget and on time as well as obtaining details of similar reference plants and projects would increase confidence in this area of the risk assessment. An existing plant that has been temporarily moth-balled or has been lying silent for a prolonged period of time, a situation that is exacerbated by extreme climatic conditions without the necessary attention to prudent maintenance practices, represents a significantly increased risk.

In these instances, the consequence of failure of the existing plant (dependent on inherent hazard, location and proximity and credible loss scenarios) could clearly have a devastating impact on the status and integrity of the 'second hand' machinery and equipment intended to be incorporated within the overall. In all situations and particularly in the case of the latter, it is recommended that detailed information be obtained relative to the operational performance, age and condition, layout and separation and maintenance and inspection history.

### **3. 2. 9 Operational History:**

In connection with key process ‘second hand’ plant items it becomes prudent to check previous throughput/output, availability and reliability achieved, successful commercial operating hours completed and any record of failures and losses where this is working in isolation or as part of a larger more complex process plant. In the case of the latter, it is suggested that a check be made on the degree to which repair (or replacement in some instances) of the machinery and equipment has been undertaken following earlier incidents.

Often in the case of repair works, the action taken may be deemed to be only ‘temporary’ in nature and ‘permanent’ solutions may only be developed at a later date prior to or during the re-erection stages of the project. In addition, it may be felt desirable to compare the data received on the ‘second hand’ plant and machinery with similar installations currently in commercial operation and ensure alignment with relevant qualifying characteristics such as temperature, pressure and unit, ‘fleet’ and overall plant historical operating performance.

The need to obtain precise up to date knowledge to ensure that the appropriate level of maintenance has been consistently applied to the machinery involved through its original normal working life may provide positive satisfaction that the machinery will be capable of operating safely and at maximum reliability during subsequent testing and commissioning phases. In general terms, the scope of the maintenance and the service time intervals that have been in place should not compromise those prescribed by the original equipment manufacturer taking into consideration the locality, environmental factors and the type of work application in which the machinery has been involved.

### **3. 2. 10 Spare Part Availability:**

There is a need to obtain detailed information relative to the availability of critical spare parts and the presence and the technical capabilities of specialist contractors to carry out the necessary repairs in professional manner. Naturally, when dealing with construction projects involving the insurance of ‘second hand’ plant, risk exposure increases significantly as the availability of spare parts for the original machinery may have become scarce driven principally by technological advancement and such parts may no longer be in manufacture given reduced global demand.

### **3. 2. 11 Summary of Risk Assessment Areas:**

Appendix 1 provides an overview of the principal areas that should be covered in the risk assessment process when considering the insurance of projects involving second hand plant and machinery together with an outline of relevant information requirements within each.

Appendix 2 provides specific examples of machinery and equipment that was subject to an independent due diligence inspection prior to purchase involving a study of existing condition and providing an outline of recommended repairs in order to enhance life expectancy for future ongoing operation.

Appendix 3 provides an overview of specific machinery and equipment-furnaces and frame saws-and outlines the principal areas of attention that are required when assessing project insurance involving second hand plant and equipment.



**Figure 4:**

**Steam-turbo generator shaft  
misalignment**

## **4.0 Policy Cover:**

### **4.1 Introduction:**

Having completed a full and detailed project assessment and analysis of the second hand plant and machinery, there becomes a need to tailor the provision of insurance cover according to the technical conclusions that have been drawn from the risk appraisal process. In dealing with any project risk falling in this sector, it becomes important to ensure that a number of essential factors are considered including a clear definition of the contract works (essentially the items that are to be considered for insurance cover as part of the project), reference made to the contract disciplines that are intended to be included (dismantling, re-erection) and the prudent application of policy language, specific exclusions and conditions that are deemed relevant and the intended basis of loss settlement.

### **4.2 The Basis of Valuation:**

It is recommended when providing project insurance involving second hand plant and equipment that the sum insured, upon which the technical policy rate is to be based for premium calculation purposes, represent the new replacement value.

Underwriters have traditionally encouraged the use of new replacement value when dealing with such construction projects given that the approach is aligned and bears logical comparison with the development of the sum insured when considering machinery breakdown insurance. When dealing with the insurance of often aging or used plant, the level of sum insured should not be based on the purchase price but rather a sum that represents the present value in purchasing a new identical machine or if unavailable, a similar new unit performing the same function given comparable size, output and capacity.

The use of such a method of valuation when approaching construction projects involving second hand machinery ensures that individual underwriter portfolios are developed using a consistent approach when insuring identical or similar machines and encourages fairness with all Insured's in addressing the premium calculation process. In addition, machinery insurers have historically applied the policy rate to the new replacement value due to the fact that in general terms, machinery insurance rarely involves catastrophic risk of loss where items are totally destroyed and where in such situations the basis of loss settlement is relatively straight forward.

More usually, the insured and the insurer are confronted with machinery losses involving partial damage where repairs can be practically executed. The insurer is thus faced with the current cost of sourcing spare parts and the provision of labour at the time of the repair which may have no relationship with or significance to the original contract price. The use of new replacement value allows consideration to be given to an appropriate and fair deductible or level of self retention as agreed between insured and insurer given the profile and demands of the individual project.

The new replacement value should include all additional costs involved and dependent upon the contract disciplines to be insured-dismantling, re-erection, testing and commissioning. Such costs could include freight charges, customs duties and local taxes that would need to be considered for indemnity in the event of that there was a need to replace the original equipment. The insured may obtain a dispensation for such costs under initial import regulations but may not obtain an exemption for such additional costs should the machinery and equipment need replacing in the event of a future insured loss.

The onus always remains upon the insured to provide details of the new replacement value and provide a breakdown of such sums insured for the major components. There is a need to ensure that the sum insured declared is kept under regular review to confirm level of adequacy given the potential impact of inflation, escalation and currency fluctuations relative to imported items.

In certain instances, it is recommended that a professional valuation be conducted by an independent specialist recognised within the industry to verify the integrity of the sum insured against current market prices, trends and conditions. Should concerns exist relative to the levels of the sums to be insured, it is recommended that the basis of loss settlement conditions be altered such that insurers will only indemnify the insured for losses in such proportion as the sum insured bears to the amount required to be insured, that is the new replacement value. It becomes essential to ensure that every critical item listed is made subject to this condition separately.

### **4.3 Insured Property:**

The policy schedule should contain a clear and accurate description of the overall project and a detailed reference to the major items that are to be insured. For example, in the case of a combined cycle power station that is to be the subject of dismantling and subsequent re-erection, there would be a need to identify the gas turbines, the heat recovery steam generators, the steam turbine(s) and transformers together with the details of the original equipment manufacturer and model/unit number, as well as providing a general commentary on any balance of plant items including switchgear.

As discussed it is vital that the policy schedule not only record the details of the critical items themselves but also the level of new replacement value commensurate with each as these could become essential and highly relevant in considering future loss adjustments.

It also becomes important to highlight any existing property present on the site of re-erection that is to be retained and potentially integrated within the process particularly where this is intended to ultimately form part of the contract works (subject also to in depth risk assessment as discussed within the relevant sections to this paper). Where existing property at the site is declared as not forming part of the contract works then these exposures can be considered along traditional lines (damage due to or arising from the carrying out of the project) normally with the provision of a policy section sub-limit. (Please refer to IMIA Working Group Paper 51/07).

#### **4.4 Basis of Loss Settlement:**

To maintain consistency with the basis of calculation of the sum insured following the example taken from that traditionally adopted for machinery breakdown insurance, it becomes entirely appropriate to follow the same approach when addressing basis of loss settlement considerations:

- a) In cases where damage to an insured item can be repaired - the Insurers shall pay expenses necessarily incurred to restore the damaged machine to its former state of serviceability plus the cost of dismantling and re-erection incurred for the purpose of effecting the repairs as well as ordinary freight to and from a repair shop, customs duties and dues, if any, to the extent such expenses have been included in the sum insured.

If the repairs are executed at a workshop owned by the Insured, the Insurers shall pay the cost of materials and wages incurred for the purpose of the repairs plus a reasonable percentage to cover overhead charges.

No deduction shall be made for depreciation in respect of parts replaced, but the value of any salvage shall be taken into account. If the cost of repairs as detailed hereinabove equals or exceeds the actual value of the machinery insured item immediately before the occurrence of the damage, the item shall be regarded as destroyed and settlement shall be made on the basis provided for in b) below.

- b) In cases where an insured item is destroyed - the Insurers shall pay the actual value of the item immediately before the occurrence of the loss, including charges for ordinary freight, cost of erection, customs duties, if any, provided such expenses have been included in the sum insured, such actual value to be calculated by deducting proper depreciation from the replacement value of the item. The Insurers shall also pay any normal charges for the dismounting of the machinery destroyed, but the salvage shall be taken into account.

The cost of any alterations, additions, improvements or overhauls shall not be recoverable under the terms of the policy.



Other forms of basis of loss settlement can be developed and may be considered more relevant where loss or damage is not purely limited to a single item of machinery and equipment. When consideration is given to the prospect of loss to second hand equipment arising for fire or elemental perils, damage may be sustained by all or a significant number of the process units insured e.g. whilst the machinery is contained in warehousing awaiting re-erection.

In such instances, it may become more practical and prudent to apply basis of loss settlement conditions that pre-agree indemnity as a maximum percentage of the new replacement value at inception of the project. This method ensures that a depreciation formula is included at inception of the policy limiting the basis of indemnity in line with previous consumption of service life. This approach not only protects the client as there is an awareness of the likely loss amount to be recovered dependent on the nature and extent of damage. This solution can benefit the insurer in that specific allowance is made to recognise the impact of depreciation and allows the loss adjustment process and the establishment of ultimate quantum to proceed in a more structured manner.

When considering project insurance involving second hand plant and equipment, it becomes important to re-iterate that there is a direct correlation between the conclusions drawn within the risk assessment section and the prudent granting of insurance cover. Specialist construction underwriters and risk engineers will formulate their own opinions as to the quality and integrity of project risk as presented within this sector.

## **4.5 Policy Exclusions and Endorsements:**

### **4.5.1 Risk Assessment Features - Positive Conclusions:**

In general terms, where the results of the risk appraisal analysis have proved to be positive and acceptable, consideration could be given to the provision of insurance cover on a conventional 'all risks' basis across all contract disciplines: dismantling, transit, re-erection, testing, commissioning and maintenance sections. Nevertheless, despite possessing a significant degree of comfort level with all aspects of the project risk, it is recommended that consideration be given to application of all or some of the following conditions and exclusions where such is deemed relevant:

#### **Exclusion: Consequences of Defects**

'The Insurer(s) shall not be liable for:

All costs rendered necessary by defects of material workmanship design plan or specification and should damage occur to any portion of the Insured Property containing any of the said defects the cost of replacement or rectification which is hereby excluded is that cost which would have been incurred if replacement or rectification of the Insured Property had been put in hand immediately prior to the said damage.

For the purpose of this policy and not merely this exclusion it is understood and agreed that any portion of the Insured Property shall not be regarded as damaged solely by virtue of the existence of any defect of material workmanship design plan or specification’.

Whilst requests to consider broader forms of ‘cover’ under the terms of the Defects exclusion (full defects cover) could be provided, this determination can only be made on the basis of the technical conclusions drawn from the risk assessment process according to the peculiarities associated with the construction project involved.

**Exclusion-Consumables:**

‘Loss of or damage to exchangeable tools, e.g. dies, moulds, engraved cylinders, parts which by their use and/or nature suffer a high rate of wear or depreciation, e.g. refractory linings, crushing hammers, objects made of glass, belts, ropes, wires, rubber tyres, operating media, e.g. lubricants, fuels, catalysts’.

**Exclusion: Existing Defects:**

‘Loss or damage caused by any faults or defects existing at the time of commencement of this Policy within the knowledge of the Insured or his representatives, whether such faults or defects were known to the Insurers or not’.

**Exclusion: Wear and Tear**

Absolute Exclusion

‘Loss or damage due to or arising from the continual influence of operation (e.g. wear and tear, cavitation, erosion, corrosion, rust, boiler scale)’

**Exclusion: Manufacturer’s Guarantees**

‘Loss or damage for which a supplier, contractor or repairer is responsible either by law or under contract’

**Extended Maintenance Provisions:**

‘It is hereby declared and agreed notwithstanding anything herein contained to the contrary that in the event of loss or damage to any machinery the basis of indemnity shall be the cost of replacing or repairing similar machinery in current production and for which replacement and manufacturers’ spares are available.

The indemnity granted hereunder shall continue for the total Maintenance Period stated in the Risk Details, after issue of a certificate of practical completion or equivalent certificate, in respect of any contract or subcontract or supply order forming part of the Project, but solely in respect of physical loss or damage to the Property Insured occurring as a result of:

- a cause occurring on the Project Site during the Period of Insurance, but prior to the commencement of the Maintenance Period or,

- operations carried out by any contractor or subcontractor for the purpose of complying with the conditions (written or implied) governing the execution of their contracts or subcontracts. Such operations to include performance of any works remaining to be undertaken during the Maintenance Period as well as any work of reconstruction, rectification or repair’.

Note: it is suggested that in the context of this study, the provision of guarantee maintenance would not generally be appropriate when considering insurance for second hand machinery and equipment.

#### **Endorsement: Obsolescence Clause**

It is hereby declared and agreed that notwithstanding anything herein contained to the contrary that in the event of loss or damage to any machinery or equipment for which it is no longer possible to secure replacement parts, machines, technical services or repairs and/or which are no longer in current production/manufacture, the basis of indemnity shall be the cost of replacing or repairing with similar machinery but only up to including the actual cash value of the original item (s).

#### **4.5.2 Risk Assessment Features-Negative Conclusions:**

Technical and integrity concerns may however exist on all or part of the Project Management or Process Technology aspects following the completion of conclusions to the formal risk appraisal process. Given the complex and varied nature of project risk relative to second hand machinery and equipment, consideration may need to be given to including some of the above clauses within the policy in addition to more specific exclusions and endorsements available to provide insurers with much greater protection during the more highly exposed testing and commissioning periods:

#### **Exclusion: Testing and Commissioning**

‘It is hereby noted and agreed that all cover provided under this policy shall cease upon the commencement of testing and commissioning activities as defined within the terms of this Policy.’

The application of this exclusion could be applied where technical concerns exist relative to project management features (including risks associated with operator error), integrity of process machinery and equipment and influence of extraneous perils on the Contract Works.

#### **Endorsement: Used Machinery - Munich Re 203**

‘It is agreed and understood that otherwise to the terms, exclusions, provisions and conditions contained in the policy or endorsed thereon, the insurers shall not indemnify the Insured for loss or damage to the insured used items:

- attributable to previous operation;
- attributable to dismantling (if dismantling is not covered);
- in respect of any non-metallic parts.’

**Endorsement: Used and /or Second Hand Plant - Swiss Re EPI 43**

‘It is hereby noted and agreed that as of the inception date of this Policy, the following Condition is added to the Special Conditions:

Notwithstanding anything contained herein to the contrary, accidental physical loss or accidental physical damage as specified in Section1 Material Damage to used and/or second hand plant or machinery, forming part of the permanent works, is covered hereunder, provided that:

- (a) cover shall only apply to such used and/or second hand plant or machinery which is refurbished where necessary, in good working condition and fit for re-use;
- (b) Insurers shall neither be liable for any loss or damage due to or caused by any defects in such plant or machinery as a result of its prior operation, nor for any loss or damage caused by testing or experiments whereby normal operating stresses, as originally designed for, are willingly exceeded;
- (c) Insurers liability shall in no case exceed the actual value of each individual item of used and/or second hand plant or machinery;
- (d) For the purpose of this endorsement actual cash value shall mean the purchase price paid for the respective item plus additional costs incurred for dismantling, refurbishing (if any), transport, erection, customs duties and other dues as applicable.’

**Endorsement: Pre-existing defect or attributable to previous operation**

An additional form of exclusionary language can be developed and applied as follows:

‘Insurers shall not be liable in respect of loss or damage to the Contract Works as defined within the Policy Schedule during testing and commissioning which is due to a pre-existing operational defect or which is attributable to previous operation but this exclusion shall not apply to:

- Loss or damage to the Contract Works from an otherwise indemnifiable cause not excluded by the terms of this Policy,
- New machinery or property.’

**Visits Maintenance Provisions:**

‘It is hereby declared and agreed notwithstanding anything herein contained to the contrary that in the event of loss or damage to any machinery the basis of indemnity shall be the cost of replacing or repairing similar machinery in current production and for which replacement and manufacturers’ spares are available.

The indemnity granted hereunder shall continue for the total Maintenance Period stated in the Risk Details, after issue of a certificate of practical completion or equivalent certificate, in respect of any contract or subcontract or supply order forming part of the Project, but solely in respect of physical loss or damage to the Property Insured occurring as a result of:

- operations carried out by any contractor or subcontractor for the purpose of complying with the conditions (written or implied) governing the execution of their contracts or subcontracts. Such operations to include performance of any works remaining to be undertaken during the Maintenance Period as well as any work of reconstruction, rectification or repair.’

### **Exclusion: Complete Defects Exclusion**

‘The Insurer shall not be liable for loss or damage due to defects of material workmanship design plan or specification’.

In applying the terms of this exclusion, it becomes important to ensure that the definition of ‘defect’ includes the prospect of ‘operational defect’ as a result of previous use, wear and tear, gradual deterioration, corrosion and erosion (including other developing modes of failure: stress corrosion cracking, fatigue).

### **Conclusions:**

Through the use of the above established approaches, the intention is to ensure that the inherent project risks are eliminated in situations where insurers have technical concerns relative to second hand machinery and equipment condition and integrity.

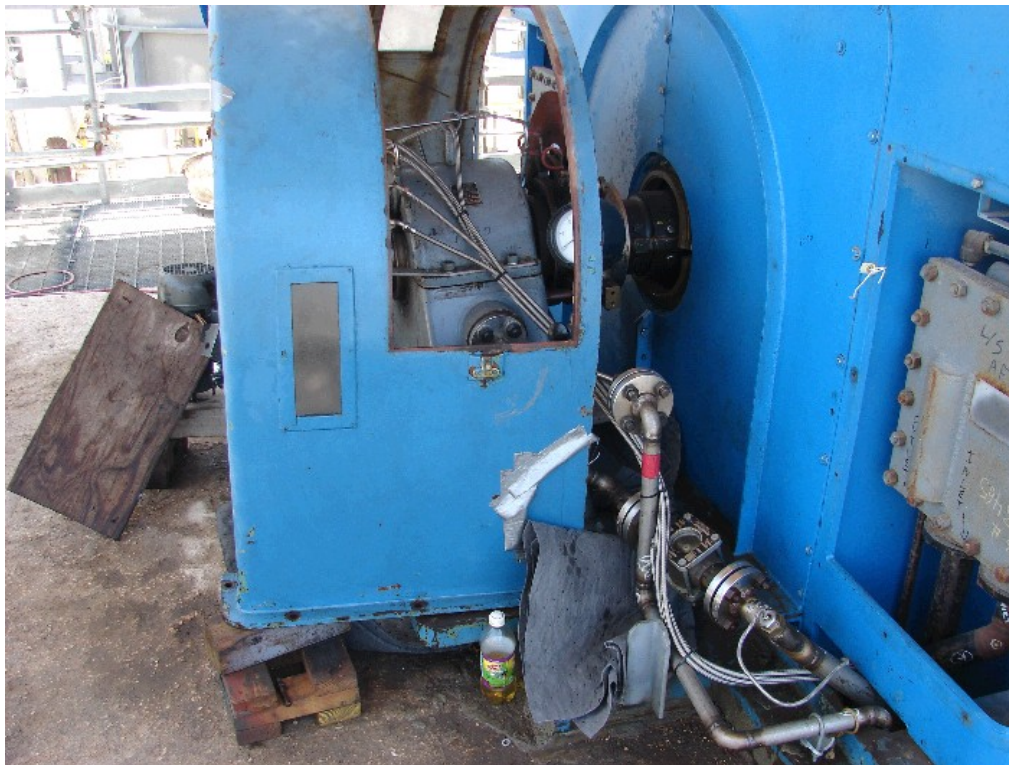
The matrix included under Appendix 4 attempts to summarise the essential features that need to be addressed in assessing the provision of policy cover for second hand machinery and equipment.

## **5.0 Claim Example:**

### **5.1 Description of Risk:**

The risk involves the operation of a small integrated crude oil refinery that produces three primary products, reformat, JP8 and diesel fuel. The insured had purchased the facilities in 1991 and in 2007, invested in a steam turbo-generator and boiler package. The unit comprised a 1948 Worthington 400 psi condensing 17 stage steam turbine and an associated 5mw generator. The insured retained the services of a specialist engineering company to evaluate and install the equipment, who in turn subcontracted refurbishment of the turbine to another local company. Further subcontract work was delegated to address installation of an up to date governor and controller. The turbo-generator was purchased for approximately US\$1.00mm with erection costs amounting to US\$1.50mm giving an overall price of US\$2.50mm in all.

After an initial six month construction period, the project ran over budget, construction work was stopped and did not resume for a further nine months. When the Insured finally started the unit up, it was noted that control problems were experienced such that although load started to increase, it could not be manually backed down requiring the Insured to perform an external trip to bring the unit off line. A number of subsequent trips performed during the last weeks of commercial operation were successful and it appears that the main stop valve would close eliminating steam to the turbine and the unit would naturally roll to a stop.



**Figure 5: Exciter housing dislodged**

## **5.2 Nature and Extent of Damage:**

During the course of manually trying to bring the unit down from an operating load of 1.50mw, the operator noted that the unit was not responding to instruction. With the generating load beginning to become slightly unstable, the operator activated the external manual trip and in doing so heard an extremely loud noise indicating a catastrophic unit over-speed.

The main shaft to the turbine was sheared off around the coupling area of the shaft and the rear bearing and surrounding casing were completely destroyed. The generator retaining ring was centrifugally destroyed and the field copper was tangled and protruding from the generator end bells. As a result, the stator was damaged by flying debris.

Following detailed technical and forensic investigation, it was decided that the prospect of repair to the turbo-generator was not possible and the unit was declared a constructive total loss. The Insured did find a replacement unit of similar vintage although this was a slightly larger machine. The unit had been the subject of refurbishment some 12 months earlier. Contingency plans to source a replacement were expected to take a minimum of six months. Plant demand and requirement continued at 3.50mw requiring the Insured to purchase alternative power by way of 'extra expense'.



**Figure 6: Main shaft to the turbine is sheared    Figure 7: Generator windings released**

### **5.3 Claim Adjustment Considerations:**

From a property damage perspective, the policy in force stipulated that ‘replacement’ shall mean ‘replacement with like kind and quality at the time and place of the loss.’ Increased costs were however incurred associated with the Insured’s reluctance to accept the replacement turbo-generator without detailed ‘due diligence’ inspection. As such, a reputable contractor was deployed to inspect and assess the condition and certify any used or refurbished parts. The contract also included management of the re-erection project and acceptance of the unit for commercial operation at significant additional cost.

From a time element standpoint, extended delays were experienced as a result of the following:

- Disputes between the construction parties on repair and/or replacement options exacerbated delays in replacing the original unit.
- Obsolescence- whilst the turbo-generator was of nominal capacity, the original manufacturer was no longer trading and therefore an identical ‘off the shelf’ replacement was not available.
- Work to prepare alternative foundation design and re-configure existing equipment was required to receive the unit which was hampered by site congestion.
- Time associated with the refurbishment and the sanctioning of salvaged parts.

There was a natural propensity on the part of insurers to attempt to associate ‘indemnity’ with ‘like kind and quality’ at competitive prices particularly as the replacement costs were always likely to exceed the purchase price of the first turbo-generator. In addition, there was an urgent need to analyse the ‘critical path’ and carry out the appropriate ‘expedition’ to ensure that the replacement turbo-generator was carried out quickly as possible. Time lines had to reflect diligence in identification, repair and refurbishment and re-erection of the replacement unit given a need to verify condition and integrity given existing insurers continuing exposure to the ‘on-going’ risk.

The property damage claim was estimated at US\$5mm with the extra expense assumed to be around US\$1mm.



## **APPENDIX 1**

### **IMIA Working Group Second Hand Plant Risk Assessment Matrix**

<b>Risk Assessment Category</b>	<b>Technical Requirements</b>
<b>Previous/Current Ownership</b>	<ul style="list-style-type: none"><li>• Reasons for the sale of the plant/machinery</li><li>• Operational history-maintenance and inspection</li><li>• Modifications from original manufacture/supply</li><li>• Major incidents requiring repair/replacement</li></ul>
<b>Owner/Operator Experience</b>	<ul style="list-style-type: none"><li>• Examine Operator's financial status</li><li>• Reasons for purchasing second hand equipment</li><li>• Expertise within the sector/territory</li><li>• Project management experience-reference projects</li><li>• Contractor selection processes</li></ul>
<b>Contractor Management</b>	<ul style="list-style-type: none"><li>• Project management experience in sector/territory</li><li>• Familiarity with second hand project disciplines</li><li>• Sub-contractor/labour force selection processes</li></ul>
<b>Manufacturers and Suppliers</b>	<ul style="list-style-type: none"><li>• Experience/track record with specific machinery</li><li>• Design and build qualities supported by QA/QC</li><li>• Technical support during the contract phases</li><li>• Plant testing in accordance with OEM instructions</li></ul>
<b>Contractual Responsibilities</b>	<ul style="list-style-type: none"><li>• Ownership/responsibility trails for purchase/supply</li><li>• Requirements for health, safety, quality, security</li><li>• Protocol where contract specifications are not met</li><li>• Ensure that policy form recognises responsibilities</li></ul>
<b>Due Diligence Report</b>	<ul style="list-style-type: none"><li>• Comment on plant condition and life expectancy</li><li>• Details of required plant repairs and replacement</li><li>• Forms basis of risk assessment and future claims</li><li>• Conducted with the dismantling contractor</li></ul>
<b>Transportation</b>	<ul style="list-style-type: none"><li>• Identify critical items-weight, size, value</li><li>• Experience of freight forwarder/contractor</li><li>• Transportation methods and packing specification</li><li>• Route, terrain and security requirements</li></ul>
<b>Identification</b>	<ul style="list-style-type: none"><li>• Details of manufacturer, brand and unit type</li><li>• Machinery capable of achieving output/capacity</li><li>• Plant meets statutory regulations and requirements</li></ul>
<b>Design and Technology</b>	<ul style="list-style-type: none"><li>• Project management meets international standards</li><li>• 'Standard' type-no prototypical, untried features</li><li>• Assess fire detection/protection/control systems.</li><li>• Highlight machinery that is obsolete.</li></ul>
<b>Age and Condition</b>	<ul style="list-style-type: none"><li>• Operational history and performance</li><li>• Review plant inspection and maintenance activity</li><li>• Assess life expectancy and failure mechanisms</li><li>• Inspection authority to endorse plant condition</li></ul>
<b>Prolonged Storage Periods</b>	<ul style="list-style-type: none"><li>• Care, maintenance and preservation plans</li><li>• Temperature/humidity controls for specific plant</li><li>• Fire detection, protection and separation</li><li>• Survey and inspection recommended</li></ul>
<b>Plant Integration</b>	<ul style="list-style-type: none"><li>• Existing plant specification and condition</li><li>• Operational history-maintenance and inspection</li></ul>
<b>Operational History</b>	<ul style="list-style-type: none"><li>• Throughput/output, availability and reliability</li><li>• Commercial hours completed and any failures</li><li>• Operated/maintained in line with OEM instructions</li><li>• Compare data received with similar installations</li></ul>
<b>Spare Part Availability</b>	<ul style="list-style-type: none"><li>• Less options where original parts discontinued</li><li>• Increased costs associated with re-manufacturing</li></ul>



## **APPENDIX 2**

The overviews provided within this Appendix relate to the re-erection of a second hand plant in the United States.

The extracts that follow provide a practical example of the extent of inspection and analysis as part of essential due diligence processes required to fully evaluate the integrity of the machinery and equipment and the degree of refurbishment and repair required to ensure that such items are in a potentially satisfactory condition for the provision of testing and commissioning cover.

The data provided herein focuses on two of the critical items within the process and namely the chlorine compressor and gearbox and the storage tanks involved. Whilst the overviews provided relate to these specific items, the detail provided serves to illustrate the depth in terms of investigation that would usually be required in the risk assessment process.

An overview of the project specification is as follows:

**EAR: Estimated Contract Value - USD 65,000,000**

**Period:**

**16th December 2004 to 31st July 2006 (includes 10 days testing and commissioning)**

**Location:**

**Longview, Washington, USA**

**Process:**

**Chemical Plant, Alkali Plant**

**29M7-4I Chlorine Compressor and Gear Box  
INCOMING INSPECTION  
REPORT**

June 2006

Subject: Incoming Inspection Findings

Company has completed the incoming inspection of subject 29M7-4I compressor, gear box and base plate and is pleased to submit this report for your records.

**INSPECTION SUMMARY (Compressor)**

- Inlet and discharge flange sealing faces are pitted and eroded. Recommendation: skim cut.
- Light erosion at diaphragm fit seal area in casing throughout. Recommendation: spot weld repair and handwork.
- Casing splitline has large visible gaps at discharge end of casing. (see blue check photos) Recommendation: grind .010" off of splitline upper and lower, line bore diaphragm ID fits in casing.
- Balance piston seal housing has extreme erosion on O.D. fit Recommendation: replace
- Both carbon seal housing flanges are bent at puller hole locations, carbon seal faces have heavy pitting and erosion inboard to moderate pitting outboard. Recommendation: skim cut and reuse.
- One of two lid alignment studs destroyed on disassembly. Recommendation: replace.
- Signs of wear on compressor to gear box coupling. Recommendation: replace
- Journal bearing base ring assembly on both thrust and coupling end are rusted and pitted. Recommendation: replace both.
- Thrust bearing active and inactive base rings are both rusted and pitted. Recommendation: replace both.
- Shaft slinger ring is worn. Recommendation: replace.
- Shaft seal ring is worn. Recommendation: replace.
- Couplings are rusted and worn. Recommendation: replace. (New couplings ordered by customer from JNTE)

**Workscope that is completed Per Quotation 10739 (Compressor)**

- Received and took incoming photos.
- Conducted incoming visual inspections, verified original equipment specifications.
- Disassembled and blasted and cleaned as required.
- Recorded coupling standoff, removed cleaned and inspected.
- Performed disassembly inspection.
- Performed and recorded incoming inspection on all critical dimensional, clearances, concentricity.
- Performed and recorded blue check inspection on horizontal splitline.
- All other components that are to be used are cleaned and inspected as required.

**Additional Workscope Recommendations Per Incoming Inspection Findings (Compressor)**

- Skim cut inlet and discharge flange sealing faces.
- Weld repair and handwork diaphragm fit seal areas throughout.
- Grind horizontal splitline min. .010" per side
- Line bore all inside fits.
- Supply new balance piston seal retainer.
- Machine and skim cut both carbon seal housings and prep for reuse.
- Supply one new lid alignment stud.
- Replace journal bearing base ring assemblies.
- Replace thrust bearing base ring assemblies.
- Sand blast base plate (skid)
- Epoxy prime base plate
- Epoxy finish paint base plate
- Fabricate and install new sole plates for new motor

**Additional New Parts Required (Compressor)**

- Laby Seal Spacers, Studs and Nuts (Qty 8)
- Slingers (Qty 2)
- Seal Ring (Qty 2)
- Journal Bearing Base Ring Assemblies (Qty 2)
- Thrust Bearing Base Ring Assemblies (Qty 2)
- Balance Piston Retainer
- Lid Alignment Stud
- Bearing Box Air Filters (Qty 4)
- Motor sole plates and Hardware

**INSPECTION SUMMARY (Gear Box)**

- Input and output gear couplings are rusted and in poor condition. Recommendation: replace. New couplings ordered by customer from JNTE)
- Main oil pump turns free with no restrictions. Main oil pump coupling setscrew missing from coupling and was found in oil sump. Main oil pump slotted drive plate on the bull gear has light wear but is in functional condition. Recommendation: clean and reuse main oil pump and replace coupling setscrew.
- Incoming bull gear float was to Elliott spec.
- Incoming gear backlash was to Elliott spec.
- Incoming gear teeth blue check is at 80% with even contact.
- Main gear case interior paint is in excellent condition.
- Bull gear bearings have light scoring throughout with moderate dings and indentions on thrust face, incoming clearance is to spec. Recommendation: reuse bearings with required handwork and polish
- Pinion bearings have light scoring throughout, incoming clearance is to spec. Recommendation: reuse bearings with required handwork and polish.
- Bull gear teeth are in good visual condition, both journals have light scoring, moderate galling near keyway on coupling fit. Recommendation: reuse bull gear with required handwork and polish on journals, coupling fit.
- Pinion was a slight runout on both journals of. 0002" with light scoring. Light scoring at laby seal area, and steel deflector ring is rough on O.D. surface. Gear teeth are in good visual condition. Recommendation: reuse pinion with required handwork and polish on journals and laby seal area. Replace deflector ring.

**Additional Workscope Recommendations Per Incoming Inspection Findings (Gear Box)**

- Received and took incoming photos.
- Conducted incoming visual inspections, Verified original equipment specifications.
- Disassembled and cleaned as required.
- Recorded coupling standoff, Removed cleaned and inspected.
- Performed disassembly inspection, blue checked gear teeth, bearing clearance, backlash and bull gear float.
- Performed and recorded incoming inspection on all critical dimensional, clearances, concentricity.
- All other components that are to be used are cleaned and inspected as required.
- Check balance pinion and bull gear
- Handwork and polish journals on pinion and bull gear.
- Assemble with reworked and new parts as required.
- Performed and recorded outgoing inspection on all critical dimensional, clearances, concentricity.

**Additional New Parts Required (Gear Box)**

- Deflector Ring
- Coupling Guard a-Ring
- Oil Temperature Gauges (Qty 4)
- Oil Pump Coupling Setscrew

**Hydro Test Compressor Casing**

- Perform hydro test on compressor casing to 80 psig per spec.

**Note 1:** This inspection finding and pricing does not include any engineering services and or work to modify any casings, housings and or parts to facilitate instrumentation upgrades.

**Note 2:** This report does not include the inspection findings or pricing for inspection and repair of the oil lube console.

We appreciated this opportunity to perform incoming inspection on your compressor, gear box and hope that our inspection services have been to your satisfaction.

Customer Service Representative

**TANK INSPECTION REPORT**  
**Ershigs WO #25837**

<b>Tank Description</b>	<b>Inspection Report</b>	<b>Conclusions</b>	<b>Suggested Repairs</b>
<b>Body Feed - 5' ID x 6' Nexus Liner</b>	Barcol hardness readings were 30-35. Corrosion barrier appears to be Satisfactory. Star fractures on bottom (9) star fractures on side (7) that require repairs (approx 16 sq ft repair area). No anchor lugs or means of anchoring	Short term - Complete the needed repairs for extent life 2-5 years  Long term - Tank has a life expectancy of 5-7 years after repairs and periodic inspections	Add 4 holddown lugs Repair star fractures by removing cracks and add new laminate.
<b>Depleted Brine - 14' ID x 13' Nexus Liner</b>	The corrosion barrier veil laminate (Nexus - 15 mils thick) is corroded and can be easy to remove. Depth of damage varies from 1/8" to 3/16". Structural wall has barcol hardness readings of 35 +/-, Holddown lugs (6 each) are damaged and two are missing. One 8" ID flange is damaged.	Short term - Substantial repairs required that would extent life 2-3 years  Long term - Do not use this tank. Better to replace than repair.	Reline the tank corrosion barrier with Nexus corrosion barrier. Replace holddowns - 2 ea Repair 8" flange
<b>Hypo Finishing -12' ID x 16' Nexus Liner</b>	The corrosion barrier and some of the structural laminate are damaged. There would be extensive repairs to structural and corrosion barrier laminates. Four anchor lugs on the tank but four more are required.	<b>Not recommended for re-use</b>	<b>Not recommended for re-use.</b>
<b>CI Vent Scrubber -12' ID x 16' Kynar Lined</b>	Overall very good condition. There is some minor repair work needed on manway joint. No anchor dogs on site.	Short term – useable Long term - 5 to 7 years of life with monitor with periodic inspections	Need 8 each anchor dogs Subcontract the Kynar repair to a local contractor.
<b>Hypo Storage - 14' ID x 30' C veil Dion 6694 resin</b>	Barcol hardness readings of 35-40. The tank bottom has some cracking near the centre. There is a 8' x 10' area needs relined in the lower 10' of the tank wall. There is a section 3' x 6' near the bottom of the tank wall that needs to be relined. There are 4 star fractures near top that should be fixed. No anchor dogs on site.	Short term - Complete minor repairs to extend life to 4-5 years  Long term - Monitor for additional repairs that will be needed in 4-5 years. Service conditions will dictate the amount of repairs in the future.	Recommend repairing of the tank wall areas as noted.  Need 24 each anchor dogs
<b>HCI Storage - 13.5' ID x 28' C veil</b>	Barcol hardness readings below 20. The corrosion barrier appears to be Severely damaged. The tank will need to be relined inside and replace the 6" full drain at bottom. No anchor dogs on site.	Short term - Substantial repairs required that would extent life 2-5 years Long term - Do not use this tank. Better to replace than repair.	Install 20 hold downs.  Recommend a complete reline of the tank.

<b>Tank Description</b>	<b>Inspection Report</b>	<b>Conclusions</b>	<b>Suggested Repairs</b>
<b>Chlorine Under pressure tank 6'IDX11' Nexus Dion 6694 resin</b>	Good condition overall. Barcol hardness readings of 40-45. No anchor dogs on site.	Short term - Use as is.  Long term - Monitor for additional repairs that might be needed in 4-5 years. Service conditions will dictate the amount of repairs in the future.	Use as is. No repairs required.  Need 8 anchor dogs.
<b>6' 10 x 6' high Nexus Dion 6694 resin</b>	Barcol hardness readings of 35-40. Poor condition overall. The side walls have been relined and are in good condition. The dome top has some cracking. The bottom and 1'-6" up the wall has crazing and cracking. There is some damage to the lower flanges. Existing hold downs are useable but rusty/corroded.	Short term - Do not use  Long term - Replace with new vessel.	Reline the lower portion of the tank.
<b>Brine Storage - 12' 10 x 20' PVC lined</b>	Poor Condition. The PVC corrosion liner needs extensive rework of the existing welds and repairs to the cracks in the lower section of the tank 4-5 LF). The top section is in fair condition. No anchor dogs on site.	Short term - Use as is.  Long term - Replace in the next 2-5 years	If used in a light corrosive service, the tank will have 2-3 years of life. Since PVC tends to become condition brittle in certain environments, repairs would be difficult to perform. Any repairs would be by an outside contractor. Need 16 anchor dogs.
<b>12' 10 x 11'-6" C veil</b>	Barcol hardness readings of 30. Overall condition is good. The tank bottom and 5' of wall have been relined.  No anchor dogs on site.	Short term - Use as is.  Long term - Monitor for additional repairs that might be needed in 4-5 years. Service conditions will dictate the amount of repairs in the future.	No repairs required.  Need 8 anchor dogs.
<b>4'10 x4' PVC Lined</b>	Good Condition.	Short term - Use as is.  Long term - Monitor for additional repairs that might be needed in 4-5 years. Service conditions will dictate the amount of repairs in the future.	Useable as is.

## **APPENDIX 3**

### **SUBJECT:- FURNACES**

#### **Introduction**

What is a furnace? It can be described as an enclosed chamber in which heat is produced to smelt or refine ores. It can be regarded as one of the most hazardous processes and requires large skill and experience to mitigate and control any unsafe acts as well as insurance losses. With the competitiveness in the smelting industry, one cannot compromise with cost, shortcut design and maintenance, to optimise output.

The smelting process is one of many, from iron making, glass making, steel making, platinum, gold, (ferros and non ferros) metal production. The writer for the purpose of this paper will concentrate mostly on arc and blast furnaces, continuous casters to provide a broad form scenario on the risk and associated problems that can be encountered on a very high level base. This short “paper” is certainly not exhaustive and can be described as for information only.

The following items, together with possible causes in the use of second hand equipment, is summarized as follows:-

- **Transformers**

Compatibility, core windings older than 3 to 5 years to be replaced. Cooling oil management crucial. Short circuit causing explosion on start-up / full load conditions.

- **Cooling Systems (Copper Waffel Coolers) Pumps, Electric Motors**

Crucial items for abovementioned. Second hand equipment can be used, but must be refurbished, attention to bearings, pump housing and impellers. All start-up capacitors to be new.

- **Refractory Linings:**

Definitely not recommended for installation or re-use if second hand. This is a “NO GO” and cannot be refurbished. Only new linings are to be fitted. They also have a very short life span from 5 to 8 years, depending on the type of furnace.

- **Furnace Hull / Chamber**

Not recommended for use if older than 10 years. The hull may be “fractured” due to the years of working stress and can cause gas, molten metal leaks.

- **Old Model / Cupola, Bessemer Converters**

Construction of clay brick outer surfaces, and refractories interior. Not recommended for second hand use, in fact these may be out of use and the actual process may be replaced with modern technology.

- **Charging Bells, Feed Conveyors, Hoppers**

The usage of all this critical equipment would require full refurbishment as new. These items are crucial in the process, once again caution for equipment older than 10 years.

- **Utilities (Water, Electrical Power, Emergency Power, Contingency Power, Overhead Cranes**

Overhead cranes, second hand, not regularly tested (infrared scanning) to be conducted. These cranes transfer tons of molten metal and may cause molten metal breakouts / spillages if not maintained.

- **Thermocouples**

Recommended to be replaced with new, as this can be identified as an expendable item.

- **Protection – Fire Protection / Water**

All new equipment with regular inspection certificates needed here.

- **Other Exposures**

- **Windstorm, Flood**

Old buildings (used to house a new plant) with inadequate water drainage systems, no fire protection, must be upgraded. New building regulations to also comply with the Safety Act.

- **Loss Control Features / General**

Construction / Erection - This specific subject requires well qualified Engineers / Contractors with experience. The Steel / Glass Industry has “modified” processes from time to time to quite an efficient layout which requires updated skills to erect / control and operate these facilities. Only well known contractors are to be employed, third party inspections are crucial.

- **Insurance Losses**

Design of furnaces as well as the experience of contractors have been a major problem in our market. The use of second hand copper waffle coolers has resulted in major losses due to insufficient cooling in a platinum smelter. The construction as well as the assets underwriter must take cognisance of these problems and it is recommended that the underwriters work closely together in the underwriting of smelters.



## **SUBJECT:- FRAME SAW**

### **Introduction**

Used for sawing a thick piece of wooden feed or log into thinner pieces of wood. The saw blades are closely spaced apart, and are driven in a reciprocating motion comprising alternate cutting and non-cutting strokes.

- **Fatigue:**

Due to the continuous vibration and tremendous force created in order to carry out heavy duty throughput of the wooden feed, cracks may develop in the sash (frame containing the blades), and con-rod, which could lead to disruption of the saw, and as a result total destruction.

- **Mitigation:**

Non-Destructive Testing (NDT) and examination to be done on a regular basis. Also a regular Maintenance programme must be in place.

- **Obsolescence:**

Frame Saws to a large extent are being replaced by band saws. This therefore compromises the availability of parts and expertise relating to the frame saw. This machinery is also fully imported, so spare parts are very expensive and therefore not readily available. This would seriously affect downtime in the event of a loss.

- **Mitigation:**

Review operational plan and Capital Expenditure budget to allow for the keeping of critical spare parts, and ultimately the replacement of machinery.

- **Burn-out:**

As an example, should a motor be replaced with a new motor, the configuration could potentially be out of alignment after tightening, resulting in failure of the machine.

- **Mitigation:**

Other than maintaining a strict maintenance schedule, none. It is an operational risk when installing new parts in an old machine. Subsequently, Insurers do not give Testing and Commissioning Cover for second-hand machinery. Another consideration is when installing a new machine on an old foundation. The foundational specifications for these machines are fairly complex, and the old foundation may not be able to accommodate the new machine.

## APPENDIX 4 – Policy Cover Matrix

### Basis of Valuation:

- Recommended that the sums insured represent the New Replacement Value
- To include additional costs – freight charges, customs duties, local taxes

### Insured Property:

- Clear and accurate description of the overall project
- Detailed reference to the major items and their replacement value
- Existing property – either forming part of the Contract Works or insured from damage due to or arising out of the project

### Basis of Loss Settlement:

- Repairable - full cost of parts and labour up to the actual value
  - Destroyed – pay the actual value immediately before the occurrence of the loss
- or
- Pre-agreed indemnity as a maximum percentage of the new replacement value according to previous consumption of service life

### Policy Exclusions and Endorsements:

Entirely dependent on the conclusions to the risk appraisal process

### Construction Period Considerations:

- Standard EAR policy involving the following disciplines:
  - Dismantling
  - Due diligence inspection
  - Transportation
  - Re-erection
  - Testing and Commissioning

### Testing, Commissioning and Maintenance Period Considerations:

#### Risk Assessment Features

#### Positive Conclusions\*

- Consequences of defects
- Exclusion – Consumables
- Exclusion – Existing Defects
- Exclusion – Wear and Tear (Absolute)
- Exclusion – Manufacturers Guarantees
- Extended Maintenance Provisions
- Endorsement - Obsolescence

#### Negative Conclusions\*

- Exclusion – Testing and Commissioning
- Endorsement – Used Machinery Munich Re 203
- Endorsement – Used and/or Second Hand Plant Swiss Re EPI 43
- Exclusion – Complete Defects
- Endorsement – Pre existing defect or attributable to previous operation
- Visit Maintenance Provision

**\*Note: Whilst this table indicates endorsements and exclusions available to be attached dependent on the outcome of the risk assessment process, flexibility and cross application in use is encouraged given the demands, merits and peculiarities of individual construction projects.**