***RISK ANALISY***

1. **DESIGN DATA**
2. **MECHANICAL RISK**
   1. Low temperature embrittlement of materials
   2. Impact or fall of the unit
   3. Rotating elements
   4. Vibration on skid
   5. High pressure
3. **ELECTRICAL RISK**
   1. Absence or inadequacy of voltage in the power panel or in the control panel
   2. Wiring
   3. Electrostatic phenomena
   4. Short circuit
   5. Contact with active parts or conductive mass became accidentally electrical active parts
4. **THERMAL RISK**
   1. External fire
   2. Equipment high temperature
   3. Equipment low temperature
5. **RISKS RELATING TO THE FLUID PROCESS**
   1. Freezing the fluid inside.
   2. Change in volume due to temperature variations
   3. Presence of fluid in the compressor
   4. Loss of lubricating effect due to emulsification
6. **RISK OF ACCESS TO THE UNIT DUE TO THE POOR ERGONOMICS**
   1. Surfaces, sharp, edges
   2. Entanglement in rotating parts
   3. Lighting of the skid
   4. Accessibility of the skid at every point
   5. Failure to comply with PPE
7. **OPERATING RISKS**
   1. Liquid hammer in pipes
   2. Tampering safety systems
   3. Incorrect installation and improper use
   4. Maintenance of the system under pressure
   5. Noise
   6. Skid handling
8. **DESIGN DATA**

For info see Technical Passport & other documents issued for this Job (for example OPERATING AND MAINTENANCE MANUAL)

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| 1. **MECHANICAL RISK** | |
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| |  | | --- | | **2.1** | |  | | |  |  | | --- | --- | | *CAUSE* | Low temperature embrittlement of materials | | *RISK EXPOSURE* | During normal operation. | | *EFFECT* | Breaking of part of the system. | | *DANGER* | Projections of metallic parts, leakage of refrigerant, possibility of explosion. | | *SOLUTION* | Piping and other equipment installed materials are chosen and certified considering minimum temperature design condition. All purchased items are chosen and certified considering minimum temperature design conditions. Special processes such as welding (Welding Books) it’s designed taking in account minimum temperature design conditions. | | *RESIDUAL RISK* | N.A. | |  |  | | --- | | **2.2** | |  | | |  |  | | --- | --- | | *CAUSE* | Impact or fall of the skid/equipment | | *RISK EXPOSURE* | During normal operation or handling/installation. | | *EFFECT* | Deformation, structural failure. | | *DANGER* | Unit permanent deformation gas leakage. | | *SOLUTION* | During normal operation all equipment installed on the skid is correctly supported to avoid falling.  The operations near the skids have to be conducted whit care to avoid impacts. | | *RESIDUAL RISK* | * Do not perform any maintenance with the equipment in operation. * Equipments must be installed in protected locations. * The installation must comply with the requirements of the user manual | |  |  | | --- | | **2.3** | |  | | |  |  | | --- | --- | | *CAUSE* | Rotating elements - In this equipment there are noting that can cause this type of risk | | *RISK EXPOSURE* | N.A. | | *EFFECT* | N.A. | | *DANGER* | N.A. | | *SOLUTION* | N.A. | | *RESIDUAL RISK* | N.A. | |  |  | | --- | | **2.4** | |  | | |  |  | | --- | --- | | *CAUSE* | Vibration on skid – In this equipment there are no possible cause of vibration that can generate risk | | *RISK EXPOSURE* | N.A. | | *EFFECT* | N.A. | | *DANGER* | N.A. | | *SOLUTION* | N.A. | | *RESIDUAL RISK* | N.A. | |  |  | | --- | | **2.5** | |  | | |  |  | | --- | --- | | *CAUSE* | High pressure | | *RISK EXPOSURE* | During normal operation | | *EFFECT* | Breaking. | | *DANGER* | Projections of metallic parts, leakage of refrigerant, possibility of explosion. | | *SOLUTION* | All equipment & item it’s purchased, designed and manufactured taking into account the maximum design pressure condition as per data sheet. Piping class specification takes into account the maximum design pressure condition depending on the line class. Each part of the system is protected with a PSV with set pressure value under or equal to that of the line where it’s installed (see data sheet). PSV have been calculated in case of external fire condition. | | *RESIDUAL RISK* | * Do not perform any maintenance with the machine in operation. * Before maintenance, perform all action necessary to assure that, the part of the system where operator works is in safe condition equalizing inside/external side pressure, venting and draining as indicated in the user manual and drawings. | | | |
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| 1. **ELECTRICAL RISK** |
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| |  | | --- | | **3.1** | |  | | |  |  | | --- | --- | | *CAUSE* | Absence or inadequacy of power supply or control panel | | *RISK EXPOSURE* | During the whole life of the equipment, also during no operation. | | *EFFECT* | System malfunction, system shutdown.  Accidental machine shutdown.  Damage and breakage of instruments. | | *DANGER* | The system works out of design conditions. | | *SOLUTION* | Level transmitter LT5855 has safety function and it’s installed in the propylene skid on Flash Drum. In case of very high Level the transmitter give a signal that mean the equipment shall be put in a safe condition. | | *RESIDUAL RISK* | * Equipment can’t work in safe condition if the LT5855 instrument is not operating. | |  |  | | --- | | **3.2** | |  | | |  |  | | --- | --- | | *CAUSE* | Wiring problems | | *RISK EXPOSURE* | During normal operation. | | *EFFECT* | System malfunction, system shutdown.  Accidental equipment shutdown.  Damage and breakage of instruments | | *DANGER* | The system works out of design condition | | *SOLUTION* | Wiring is designed to ensure the proper functioning of the system during normal operation.  Level transmitter LT5855 has safety function and it’s installed in the propylene skid on Flash Drum. In case of very high Level the transmitter give a signal that mean the equipment shall be put in a safe condition. | | *RESIDUAL RISK* | * If wiring problem occur please put in safety condition GEA equipment & solve the problem as soon as possible * Equipment can’t work in safe condition if the LT5855 instrument is not operating | |  |  | | --- | | **3.3** | |  | | |  |  | | --- | --- | | *CAUSE* | Electrostatic phenomena | | *RISK EXPOSURE* | During normal operation. | | *EFFECT* | Electrostatic charge. | | *DANGER* | Electric shock, possible injury to workers and maintenance personnel. | | *SOLUTION* | All parts of unit is equipotential with main earth connection by appropriate means. | | *RESIDUAL RISK* | * Check periodically good efficiency of equipotential connection | |  |  | | --- | | **3.4** | |  | | |  |  | | --- | --- | | *CAUSE* | Short-circuit | | *RISK EXPOSURE* | During normal operation. | | *EFFECT* | Malfunction, instruments and other electrical parts fault. | | *DANGER* | The system works out of design condition. | | *SOLUTION* | Level transmitter LT5855 has safety function and it’s installed in the propylene skid on Flash Drum. In case of very high Level the transmitter give a signal that mean the equipment shall be put in a safe condition. | | *RESIDUAL RISK* | * Equipment can’t work in safe condition if the LT5855 instrument is not operating | |  |  | | --- | | **3.5** | |  | | |  |  | | --- | --- | | *CAUSE* | Contact with active parts or conductive mass became accidentally electrical active part | | *RISK EXPOSURE* | During normal operation. | | *EFFECT* | Malfunction, instruments and other electrical parts fault.. | | *DANGER* | Electric shock, possible injury to workers or maintenance personnel.. | | *SOLUTION* | All metallic and conductive mass are connected with main earth node. All active parts are segregated in an enclosure. Power supply of instruments is 24V. | | *RESIDUAL RISK* | * Power supply system shall be designed and installed according to national low & with protection device against electrical contact. | | |

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| 1. **THERMAL RISK** |
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| |  | | --- | | **4.1** | |  | | |  |  | | --- | --- | | *CAUSE* | External fire | | *RISK EXPOSURE* | During the whole life of the equipment, also during no operation. | | *EFFECT* | Increasing of temperature outside the equipment,. Increased pressure inside the unit. Explosion | | *DANGER* | Projections of metallic parts, leakage of refrigerant, possibility of explosion.. | | *SOLUTION* | All parts of the system are protected by PSV calculated in case this event will occur. | | *RESIDUAL RISK* | N.a. | |  |  | | --- | | **4.2** | |  | | |  |  | | --- | --- | | *CAUSE* | Equipment high temperature | | *RISK EXPOSURE* | During normal operation. | | *EFFECT* | Injuries of the workers. | | *DANGER* | Burning of people who came into contact with the high temperature components. | | *SOLUTION* | Equipment & piping are adequately insulated. Max temperature is indicated in plates & user manuals of item installed. | | *RESIDUAL RISK* | * Make sure that the insulation is in good condition. | |  |  | | --- | | **4.3** | |  | | |  |  | | --- | --- | | *CAUSE* | Equipment low temperature | | *RISK EXPOSURE* | During normal operation. | | *EFFECT* | Injuries of the workers. | | *DANGER* | Burning of people who came into contact with the low temperature components. | | *SOLUTION* | Equipment & piping are adequately insulated. Min temperature is indicated in plates & user manuals of item installed. | | *RESIDUAL RISK* | * Make sure that the insulation is in good condition. | | |

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| 1. **RISKS RELATING TO THE FLUID PROCESS** |
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| |  | | --- | | **5.1** | |  | | |  |  | | --- | --- | | *CAUSE* | Freezing the fluid inside | | *RISK EXPOSURE* | During expected life of the machine, also during no operation. | | *EFFECT* | Increase in internal volume & breaking of the system | | *DANGER* | Projections of metallic parts, leakage of refrigerant, possibility of explosion | | *SOLUTION* | During normal operation, this type of risk will never occur.  Before charge of refrigerant it’s necessary to drain correctly the system. | | *RESIDUAL RISK* | * Check insulation efficiency periodically | |  |  | | --- | | **5.2** | |  | | |  |  | | --- | --- | | *CAUSE* | Change in volume due to temperature variations in vessel fool of liquid | | *RISK EXPOSURE* | N.A. | | *EFFECT* | N.A. | | *DANGER* | N.A. | | *SOLUTION* | N.A. | | *RESIDUAL RISK* | N.A. | |  |  | | --- | | **5.3** | |  | | |  |  | | --- | --- | | *CAUSE* | Presence of liquid in the compressor | | *RISK EXPOSURE* | N.A. | | *EFFECT* | N.A. | | *DANGER* | N.A. | | *SOLUTION* | N.A. | | *RESIDUAL RISK* | N.A. | |  |  | | --- | | **5.4** | |  | | |  |  | | --- | --- | | *CAUSE* | Loss of lubricating effect for emulsification of lube oil – Equipment is oil free | | *RISK EXPOSURE* | N.A. | | *EFFECT* | N.A. | | *DANGER* | N.A. | | *SOLUTION* | N.A. | | *RESIDUAL RISK* | N.A. | | |

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| 1. **RISK OF ACCESS TO THE UNIT DUE TO THE POOR ERGONOMICS** |
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| |  | | --- | | **6.1** | |  | | |  |  | | --- | --- | | *CAUSE* | Surfaces, sharp, edges | | *RISK EXPOSURE* | During normal operation. | | *EFFECT* | Equipment could be manufactured so that can cause danger to workers or maintenance personnel. | | *DANGER* | injury to the personnel working in the area of the equipment. | | *SOLUTION* | Where possible all skid/equipment are manufactured removing sharp, edges and other potentially dangerous shapes. | | *RESIDUAL RISK* | * The access to the equipment is allowed only for authorized personnel, who must be provided with the appropriate personal protective equipment. | |  |  | | --- | | **6.2** | |  | | |  |  | | --- | --- | | *CAUSE* | Entanglement in rotating parts – there are no rotating parts in this equipment | | *RISK EXPOSURE* | N.A. | | *EFFECT* | N.A. | | *DANGER* | N.A. | | *SOLUTION* | N.A. | | *RESIDUAL RISK* | N.A. | |  |  | | --- | | **6.3** | |  | | |  |  | | --- | --- | | *CAUSE* | Lighting – is not in the scope of purchase | | *RISK EXPOSURE* | N.A. | | *EFFECT* | N.A. | | *DANGER* | N.A. | | *SOLUTION* | N.A. | | *RESIDUAL RISK* | N.A. | |  |  | | --- | | **6.4** | |  | | |  |  | | --- | --- | | *CAUSE* | Accessibility of the skid at every point | | *RISK EXPOSURE* | During normal operation | | *EFFECT* | Maintenance technician can’t safely reach all parts and components of the equipment. | | *DANGER* | injury to the personnel working in the area of the unit . | | *SOLUTION* | Design takes in account aspect as safely accessibility to all important parts of the system. | | *RESIDUAL RISK* | * The access to the equipment is allowed only for authorized personnel, who must be provided with the appropriate PPE. | |  |  | | --- | | **6.5** | |  | | |  |  | | --- | --- | | *CAUSE* | Failure to comply with PPE | | *RISK EXPOSURE* | During the whole life of the plant . | | *EFFECT* | injury to the personnel. | | *DANGER* | injury to the personnel working in the area of the unit. | | *SOLUTION* | Is indicated in the use and maintenance instructions that the access to the equipment area is accepted only to the personnel wearing the appropriate PPE. | | *RESIDUAL RISK* | * The access to the machine is allowed only to authorized personnel who must be provided with the appropriate PPE. | | |

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| 1. **OPERATING RISKS** |
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| |  | | --- | | **7.1** | |  | | |  |  | | --- | --- | | *CAUSE* | Liquid hammer in pipes - there are no possibility that this event will occur | | *RISK EXPOSURE* | N.A. | | *EFFECT* | N.A. | | *DANGER* | N.A. | | *SOLUTION* | N.A. | | *RESIDUAL RISK* | N.A. | |  |  | | --- | | **7.2** | |  | | |  |  | | --- | --- | | *CAUSE* | Tampering safety systems | | *RISK EXPOSURE* | During normal operation. | | *EFFECT* | Limits are exceeded in terms of allowable temperature and pressure, breaking equipment . | | *DANGER* | Projections of metallic parts, leakage of refrigerant, possibility of explosion. | | *SOLUTION* | PSV are protected by a special seal leaded.  Upstream valve psv are locked open with a padlock | | *RESIDUAL RISK* | * The access to the equipment is allowed only for authorized personnel | |  |  | | --- | | **7.3** | |  | | |  |  | | --- | --- | | *CAUSE* | Incorrect installation and improper use | | *RISK EXPOSURE* | During the whole life of the plant . | | *EFFECT* | System malfunction, breakage of the equipment. | | *DANGER* | Spill of pressurized gas, explosion . | | *SOLUTION* | Installation must be in accordance with the laws in force in the country of final use and must be agreed with the manufacturer of the machine.  Comply with the construction drawings. | | *RESIDUAL RISK* | * The access to the machine is allowed only for authorized personnel. * Installation has to comply with the construction drawings * Installation must be in accordance with the laws in force in the country of final use | |  |  | | --- | | **7.4** | |  | | |  |  | | --- | --- | | *CAUSE* | Maintenance of the system under pressure | | *RISK EXPOSURE* | During the whole life of the plant . | | *EFFECT* | Maintenance is not performed properly . | | *DANGER* | Projections of metallic parts, leakage of refrigerant, possibility of explosion. | | *SOLUTION* | The maintenance activity shall be performed when the system is stopped & in safe condition.  Before maintenance activities item must be intercepted and de-pressurized. | | *RESIDUAL RISK* | * The maintenance activity should be performed when the system is off & in safe condition. * Before maintenance activities item must be intercepted and de-pressurized . | | |  |  |  | | --- | | **7.5** | |  | | |  |  | | --- | --- | | *CAUSE* | Noise – Equipment don’t generate noise itself | | *RISK EXPOSURE* | N.A. | | *EFFECT* | N.A. | | *DANGER* | N.A. | | *SOLUTION* | N.A. | | *RESIDUAL RISK* | N.A. | |  |  | | --- | | **7.6** | |  | | |  |  | | --- | --- | | *CAUSE* | Skid handling | | *RISK EXPOSURE* | During the positioning of the equipment.  During the disposal of the equipment . | | *EFFECT* | Equipment damage, breakage of some components . | | *DANGER* | Accidents to the personnel working in the area of the machine. | | *SOLUTION* | Lifting equipment procedure as well as the total weight of the group are shown in the operating and maintenance manual . | | *RESIDUAL RISK* | * During handling control the efficiency of the lifting devices used . | | |