Risk Management Considerations for Projects

The intent of this document is help project teams address risks during the design and construction of a project. Unfortunately, not everything is covered, as this writer has not thought or heard of every thing. This document was developed because of a need expressed by designers and engineers, and should provide risk management assistance during the construction of future telescopes and buildings. If you have anything to add from your experience, please contact Chuck Gessner. This document discusses risk management and includes lists (thought starters) with the intent to prompt the project team into addressing risks that might have consequences if not considered.

RISK MANAGEMENT

Put away your calculators, this is more art than science; factors like frequency and severity can be subjective. This section's intent is not to make you a risk management professional, it is simplified, to get the job done and hopefully nothing bad has happened to your project. Risk Management is planning, organizing, leading and controlling business activities with the intent to minimize or reduce the effects of risks.

Safety and Risk Management

Take a holistic approach and view safety and risk as the same. Safety is the control of accidental loss and is managed by planning, organizing, leading and controlling.

What is Risk

Simply stated: "the chance loss." Loss of our time, funds, staff, equipment, and programs are examples of loss.

Thoughts about Risks

- ❑ Life is inherently risky, there are risks in every endeavor
- ❑ Information related to project risk control is limited
- ❑ Consequences of risks are not equal, some are much more catastrophic
- ❑ The risks we don't prepare for are the ones that surprise us.
- ❑ Our job is to determine the benefits of managing specific risks and conducting cost benefit analysis.
- ❑ Known risks, having to do with the safety of people, must be controlled or eliminated!
- ❑ Risk management is an evolving learning process
- ❑ You don't know what you don't know or I don't even know enough, to know what I don't know
- ❑ Risk management cannot be done in a vacuum; involve others and ask them about their experiences.
- ❑ Accidents are caused by a series of events, not one cause (Theory of Multiple Causes), therefore, if we control one of the events in the series, we have a good chance of avoiding an accident

Risk Control

When we identify hazards that are unacceptable project risks, we implement "risk management principals" to bring the risks to an acceptable levels (ALARP, As Low As Reasonably Possible). Here's where the science breaks down, acceptable level to whom? This is where the project manager and the project team will have to determine what is "safe" and then justify their logic. The project team must determine what standards of risk management will be used, what the public would think if there was a failure, events in our current laws, trends on tort cases, what the customer expects, and others. There are many different ways to evaluate risks, usually by the probability and severity of the expected outcome. Rather than delving into complicated models, we will keep it simple.

Risk Management Principles - How can we manage risks?

- Isolate – separate people from the risk; examples are machine guarding, railings, and personal safety gear.
- Reduce – reduce the amount of exposure, use less of the substance or less frequent
- Treat – Neutralize it, write and follow procedures, training
- Substitute – Change to a less risky alternatives: use different chemicals or tools
- Accept or Tolerate – roll the bones, think long and hard with this one or evaluate and analyze.
- Transfer – to an insurance company (not everything can be insured) or contractor
- Terminate – eliminate the risk
- Avoid – we are not going to do "that"
- Protect –others by fixed protection, such as sprinklers systems or warning systems
- Spread – share the risk between investors or involved parties (caution – usually financial risks)

A Simple Way to Address Project Risks

At least review the lists in this document and create action plans to address the risks related to your project or use the following concepts to create a risk mitigation plan.

Risk Mitigation Plan
Prepare a list in a format that you can use throughout the project, this type of list has been called a Risk Action Plan, Hazard Summary, Risk Mitigation Plan, Risk Register and others. Call it what you like, its intent is to document and keep track of identified risks that arise during the project, either during design and planning meetings or events that occur during the project. The project team may find useful risk information from their experience and other resources such as hazard surveys, hazard indices, accident reports, near miss reports, critical task identification, safety audits and inspections, and the lists in this document. Columns on the list may include the following:

- An identifier number
- Area
- Discipline
- Work Breakdown Structure
- Description of the risk
- Expected Consequence (what is reasonably expected to happen)
- Probability (or likelihood)
- Severity (or seriousness)
- Risk Grading (from the Risk Matrix, see below)
- Mitigation actions (or Action Plan)
- Risk Grading due to actions taken (Change)
- Type of mitigation strategy (from Risk Management Principles, like Isolate It)
- Person Responsible
- Estimated Cost
- Actual Cost
- Status
- References
- Other Notes

Risk Matrix
As you identify project risks, add them to the Risk Mitigation Plan and refer to the table below to "quantify the risk," assign severity and probability to the risk and determine the risk grading. Risk gradings with (1) One are considered to be of highest priority and so forth. Yes, there is some judgment assigning the probability and severity and what is considered critical in the risk grading.

Risk Matrix

Loss Potential Severity

		Low	Medium	Medium-high	High
Probability	**High**	**3**	**2**	**1**	**1**
	Medium-high	**3**	**2**	**1**	**1**
	Medium	**3**	**2**	**2**	**2**
	Low	**3**	**2**	**3**	**3**

Risk Mitigation Actions for Grades of Risk
A possible management format related to the grade rating that may help with the mitigation actions for the identified risk:

(1) Actions to reduce the grade rating to be identified and implemented at project start or when the risk is identified

(2) Actions to reduce the grade rating to be identified and appropriate actions implemented during project execution.

(3) Actions to reduce the likelihood and seriousness to be identified and costs for possible action if funds permit.

(4) No action is needed unless grade rating increases over time.

When reviewing the Risk Mitigation Actions the project team should consider what is good practice and good design principles, demonstrate design safety principles meet legal requirements, demonstration that chosen option is the lowest risk or justify if not, should compare action with best practice, confirm that resultant risk is no greater than the best of existing designs, the risk is considered over life of facility, and Societal concerns met, if required to consider.

What's at Risk? (Things the Project Manager Should Worry About)

- Employees, Management, Sales, and Production
- Contractors
- Customers, Applicators, Distributors, and End Users
- Public, on site and off site
- Owned Property, Facilities, Production, Warehouses, Headquarters
- Research and Development, Tests in Progress, Radioactive Materials, and Records
- Computers, Telecom and communication systems
- On and Off site environment – air, water, and land
- Licenses and Patents
- Cash and Financial Assets
- Transportation Equipment, vehicles, aircraft, and products in transit

What are the Hazards, Exposures and Perils? (What the Project Manager Should Worry About)
Exposure - A condition where risk can cause loss
Peril - Immediate cause of loss like flood, fire or theft
Hazard - A condition that increases the likelihood of loss

Natural Hazards	**Machinery Breakdown**	**Utility Failure**
Altitude	Computer Failure	Computer systems
Cave-in	Corrosion and Erosion	Electrical
Changes in temperature	Electrical overload	Electronic
Drought	Implosion/ Vacuum	Gas and Steam
Dust	Material Handling	Radio – repeaters and equipment
Earthquake	Mechanical	Telephone
Erosion	Pipe Failure	Waste streams
Evaporation	Sprinkler	Water and Sewer
Evasive vegetation	Leakage/Accidental Discharge	
Expansive soil	Structural Failure/ Collapse	**Transportation - Accidents - Perils**
Fire from natural causes	Vibration	Aircraft
Flooding	Water hammer	Icing
Freezing and Ice	Wear and Tear	Air turbulence
Fungi, mildew, mold		Sonic booms
Hail	**Release or Spill**	Motor Vehicle
Humidity	Asbestos/Silica	Road quality
Hurricanes	Occupational Disease	Pipeline
Lightning	Biohazards	Railroad
Meteors	Contamination	Watercraft
Rainstorms	Cryogenics	Icebergs
Static electricity	Excessive odor	Waves
Subsidence/Landslides	Gases/ Chorine	

Tides and tidal waves Vermin Volcanic eruption Wind -tornado, hurricane **Fire and Explosions** Vapor Cloud Combustible Smoke	Hazardous Materials Hydrocarbons Pollution Radioactive materials	Sandbars and reefs
Human Error Employee/ operator Public Contractor Omission of safety features in the design **Deliberate Acts** Arson Embezzlement Extortion, kidnap and ransom Forgery Fraud Riot Sabotage Strikes Terrorism Theft Vandalism War	**Errors and Omission** Acquisition / Takeover Anti –Trust Breach of contract Confiscation Contractual liability Fiduciary duty Financial transactions Harassment/Discrimination Inadequate disclosure Management - Directors and Officers (D&O) Non-payment Wrongful termination **Regulatory Changes** Changes in standards, like OSHA and EPA Currency fluctuations Depression/recession Inflation Political Risk Stock market decline Taxation	**Products** Discoloration Engineering design Failure to perform Misapplication Overspray Shrinkage Warranty **Supplier Failure** Failure to perform No supply Strike **Societal** Changes in consumer tastes Customs Holidays and events Language Interpretation of communications Social Change Technology Change

Project Items That Should Be Considered by the Project Manager

- ❑ Who are customers or stakeholders?
- ❑ Who should be on the team?
- ❑ Is there a well-defined organization with responsibilities, competence and authority clearly detailed?
- ❑ Cross training and successor ship considered, especially for critical designs and processes considered?
- ❑ How will overtime be handled?
- ❑ Meetings - when and how often?
- ❑ What type of cost accounting systems and programming will be used?
- ❑ What type of filing system will be used for project documents?
- ❑ Is there adequacy of health and safety (risk management) advice?
- ❑ Safety in all aspects of the job – design, engineering, construction, training, commissioning, and operation.
- ❑ Contractors – will there be a Contractor Safety, Health and Environmental Assessment?
- ❑ What are the risks to the project?
- ❑ What codes, standards and norms will be followed?
- ❑ What are the types of insurance needed to protect “pure” risks?
- ❑ Have engineering procedures been established?
- ❑ Have alternative construction and engineering methods and techniques been considered to enable the project to save cost and schedule?
- ❑ Contracted engineering - cost plus/or firm bid or others?
- ❑ Who order materials? – company or engineering firm?
- ❑ Progress reports - what format, how often?
- ❑ Who orders spares?
- ❑ Who does expediting?
- ❑ Operation and maintenance manuals and procedures - who does them?

- ❑ Has engineering and procurement deliverables been prioritized to positively influence the critical path construction requirements?
- ❑ Have items that should be prefabricated or preassembled in the shop been identified to help reduce cost or improve schedule?
- ❑ Consider designs are configured to maximize construction efficiency?
- ❑ Consider standardized designs wherever possible?
- ❑ Has there been input to plant and equipment layouts to facilitate construction and maintenance access?
- ❑ Who develops procedures to for safe operation, maintenance and repair?
- ❑ Construction - union vs. non-union, cost plus/or firm bid?
- ❑ Type of construction contracts - use of general and subcontractor or various contractors reporting to the project manager?
- ❑ What types of computers, formats, language, programs will be used?
- ❑ Web site? What's included?
- ❑ When and how often are photographs taken? Who will be the photographer?
- ❑ What type of training is required for operators?
- ❑ Who does training?
- ❑ Who's responsible for start-up?
- ❑ How will start-up be handled? - separate start-up group?
- ❑ What type of start-up system used? - cold vs. hot commissioning, who pushes buttons?

Regulations, Codes and Standards Considerations

- ❑ Define governing safety regulations, standards, codes and organizations:
    - Country laws and codes like OSHA,
    - Local codes, State, County and City,
    - State Mining Code, if blasting or "mining",
    - Company Policy, Procedures and Rules,
    - International Building Codes,
    - And Others.
- ❑ Ensure project team is using the proper edition of the code(s) and standards.
- ❑ Budget for the codes and standards, many cost.
- ❑ Involve outside expert to review the design.
- ❑ Many Insurance companies have services for review.
- ❑ Review OSHA checklist and OSHA designer's guide.
- ❑ Equipment may have operations and maintenance special requirements and/or warnings.
- ❑ Involve the company Risk Management, Safety, Environmental, and Legal Departments during the project (especially during the design phase). It can cost more if you wait.
- ❑ Research past similar projects inside or outside the company.
- ❑ Determine what governmental agencies must be contacted and what permits will be required.
- ❑ Keep complete, extensive and written records of all conversations with agencies; send summary of conversation to them for their approval and then publish.
- ❑ List the typical organizations and regulatory requirements in the design criteria.

PROJECT COMMUNICATIONS

A risk that the project manager must address is one involving the project team. It's the risk of inadvertently leaving someone out of communication. The following lists address project communications

Reviews and/or Approval of Documents

- ❑ Design Criteria -who sees, who reviews who approves?
- ❑ Scope of Work - who sees, who reviews, who approves?
- ❑ Requisitions or O.R.'s - who sees, who reviews, who approves?
- ❑ Purchase orders or P.O.'s - who gets copies?
- ❑ Process testing - who gets copies?
- ❑ Drawings issued for approval - who reviews, who approves?
- ❑ Drawings issued for construction - who approves?
- ❑ Specifications - who sees, who reviews, who approves?
- ❑ Contracts - who reviews, who approves, who gets copies?
- ❑ Other key documents (i.e. expediting reports) - who gets copies?
- ❑ Meeting notes, who does them and who gets copies?

Meeting Participation

- ❑ Will weekly or monthly status meetings be held?
- ❑ Will weekly or monthly status reports and schedules be issued?

Model Agenda Items for a Project "Kick Off" Meeting

- ❑ Assign someone to record the minutes of the meeting.
- ❑ Review the project initiator or request for project.
- ❑ Make sure the operating department has assigned a contact person who will work with the project manager and engineers. This contact person will be the key person for information gathering and distribution. The contact person will have authority to make decisions or get other approvals.
- ❑ Outline responsibilities of key players (i.e. project engineer, operating department engineer, organization and resources).
- ❑ Get a clear idea of the scope of work.
- ❑ Get a clear idea of the design criteria and begin assembly of the design criteria.
- ❑ Outline project work breakdown structure.
- ❑ Outline documentation distribution.
- ❑ Discuss safety, environmental, and other permitting requirements or concerns.
- ❑ Summarize meeting and distribute meeting notes (after they are typed up).

ENGINEERING

Items to Watch during the Engineering Phase

- ❑ Specifications - changes?
- ❑ Engineering organization
- ❑ What disciplines are required?
- ❑ Overtime - who gets it?
- ❑ Overlap of resources
- ❑ Engineering analysis - pros and cons to decisions
- ❑ Emphasis on design with safety considerations
- ❑ Existing Designs considered
- ❑ Engineering contracts?
- ❑ Engineering guidelines and procedures
- ❑ Procedures for changes of engineering scope of work?
- ❑ Approvals for various documents?
- ❑ Document distribution
- ❑ Drawing size and type
- ❑ Drawing registers
- ❑ Drawing status
- ❑ Reproduction - what is needed and what are the costs?
- ❑ Equipment list(s)

Sample Code and Standards List for the Design Criteria

Unless specifically stated otherwise, the design, construction, and operation of the project shall be in accordance with the latest issue of the applicable portions of the following codes and standards of the following organizations and are intended to reflect the minimum acceptable standards and requirements to be followed for material and workmanship:

ADA	Americans with Disabilities Act
AISC	American Institute of Steel Construction
ANSI	American National Standard Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CGA	Compressed Gas Association
DOT	Department of Transportation - Transportation of Hazardous Materials
EPA	US Environmental Protection Agencies
EWP	European Working Panel, Turbo Compressors for Oxygen Service – Code of Practice
ISA	Instrument Society of America

MSHA Mine Safety and Health Administration – if mining or blasting
NEC National Electric Code
NEMA National Electrical Manufacturers Assoc.
NFPA National Fire Protection Association
OSHA Occupational Safety and Health Administration
SSPC Steel Structures Painting Council
TEMA Tubular Exchanges Manufacturer's Association
UBC Uniform Building Code

Design Criteria Safety Items

- ❑ Does the design comply with company policy?
- ❑ Have all applicable codes and standards been met?
- ❑ Does the design reflect good engineering practice?
- ❑ Are there features to facilitate good housekeeping?
- ❑ Can some areas become a trap in an emergency or fire?
- ❑ Is there access for emergency equipment and personnel?
- ❑ Will the construction interfere with other processes or construction phases?
- ❑ Is the design aesthetically appealing?
- ❑ Overhead obstructions - power lines?
- ❑ Underground obstructions - utilities?
- ❑ Soil structure considered?
- ❑ Seismic zone?
- ❑ Weather considered?
- ❑ Elevation considered?

Safety Line Items for the Scope of Work

- ❑ Engineering – prepare safety guidelines, codes special concerns
- ❑ Contractor - Safety Guidelines
- ❑ Project Safety Objectives
- ❑ Overall Incident Rates and Statistics

Designer' s Physical Safety Review

Identify potential hazards and controls inherent to the finished design of the project, from OSHA checklist, your experience and the experience of others, and the list below. Do these thing pertain to your project and if so have you addressed them?

- ❑ Access and Escape Routes
- ❑ Access to equipment at heights, platforms, elevated surfaces, tie off points and fixed ladders
- ❑ ADA considerations
- ❑ Battery stations require special ventilation
- ❑ Boiler and pressure vessels require code compliance
- ❑ Catchments for oil and other process spillage
- ❑ Change rooms
- ❑ Chemical storage areas for operations
- ❑ Chemical storage areas for bulk, catchments, auto shut offs
- ❑ Compressed air and systems
- ❑ Compressed gas cylinder storage area, a positive means of tying off
- ❑ Consider safety of maintenance personnel
- ❑ Cranes - labeling
- ❑ Drinking water – water fountains
- ❑ Egress related to hazardous activities require two exits
- ❑ Electrical – including electrical shutoff points
- ❑ Electrical outlet distribution, clean and "dirty" power
- ❑ Emergency Alarms
- ❑ Emergency equipment, specialty
- ❑ Emergency lighting
- ❑ Emergency power
- ❑ Exiting and egress considerations, exit doors
- ❑ Eye wash and shower stations, when working with hazardous chemicals
- ❑ Fire alarms

- ❑ Fire Extinguisher locations
- ❑ Fire suppression – fixed sprinklers and other automatic extinguishing systems
- ❑ First Aid Stations
- ❑ Flammable liquid storage requires grounding and ventilation
- ❑ Floors and wall openings, covered barricaded
- ❑ Floor loading, ensure the design load handles the heaviest components and the equipment that moves it
- ❑ General public access and control
- ❑ Hazardous wastes processing and storing waste streams, not just down the drain
- ❑ High voltage electrical systems require fencing and sometimes fire suppression
- ❑ Hoist and auxiliary equipment for equipment movement and repairs
- ❑ Identification of piping systems
- ❑ Illumination, working and office
- ❑ Keep fume hoods away from egress
- ❑ Keep outlets away from wet areas, if necessary use GFIC's
- ❑ Labeled all circuit breakers and panels
- ❑ Laser Use - Lighted warning signs
- ❑ Lightning Protection
- ❑ Lunch/eating areas separate from work areas
- ❑ Machine Guarding -All moving parts shall be guarded
- ❑ No Smoking Zones and smoking zones
- ❑ Noise control
- ❑ Oxygen deficiency or hazardous gas alarm systems
- ❑ Penetrations between rooms/buildings may require fire-stopping material
- ❑ Confined spaces must be identified and with proper signage
- ❑ Restrooms and sanitary systems for the occupancy
- ❑ Security systems, keys, cards, identification, cameras, fencing, intercoms (could tie in with communication), landscaping
- ❑ Shielding from radiation sources, x-ray require lead walls
- ❑ Signs – rooms- exit – warning
- ❑ Stairs and Stairways require landings
- ❑ Storage for things, warehouses require special design
- ❑ Surge Protection
- ❑ Tanks, bodies of liquid, and catchments require rescue equipment
- ❑ Temperature extremes
- ❑ Tie off points for future "hard to access" maintenance
- ❑ Types of walking surface coatings to reduce slipping hazards
- ❑ Vehicle Traffic, man doors by garage doors
- ❑ Ventilation / special requirements for clean rooms or hazardous environments
- ❑ Ventilation systems for specialty task – i.e. labs and process fumes
- ❑ Walkways, no obstructions
- ❑ Workstation designs (ergonomic considerations)

Designer's Guide to Potential Construction Safety Hazards

- ❑ Excavations require extensive training and control
- ❑ Shoring
- ❑ Incomplete and therefore unstable structures
- ❑ Interface with on going operations
- ❑ Overhead lifting, no one under suspended load, critical lift plans
- ❑ Connections to existing systems
- ❑ Conflicting tasks
- ❑ Clearances when moving equipment in or out
- ❑ Weight limits of floors and other structures
- ❑ Scaffolding require extensive training and control
- ❑ Electrical Hazards
- ❑ Vehicle traffic
- ❑ Security
- ❑ Confined spaces
- ❑ Burning and welding
- ❑ Fall protection
- ❑ Communications, radios, phones, intercoms, alarms and warnings

- ❑ Emergency response
- ❑ Public and media response
- ❑ Cultural differences
- ❑ Housekeeping, planned lay down areas
- ❑ Work shifts

Design Considerations for Operations

- ❑ Has equipment been located considering efficiency of material flow and human activity?
- ❑ Have clearance requirements around the equipment included maintenance and replacement? Who will define clearance criteria?
- ❑ Will design include new operations?
- ❑ Provide "off the floor" access for as many operations and maintenance activities as possible.
- ❑ Consider close access to frequently used tools.
- ❑ Consider environmental controls if the operators will remain stationary for long periods.
- ❑ Has proper lighting been provided for the operators?

Design Considerations for Repairs

- ❑ Consider frequency of maintenance when locating equipment and setting clearance requirements.
- ❑ Can the equipment be modified to improve accessibility?
- ❑ Provide power and light sources conveniently located for maintenance.
- ❑ Provide easy access such as removable platforms or guardrail, for equipment and materials.
- ❑ Provide clearance and hoist supports for major components replacement.
- ❑ Can connection locations (hydraulic, electric, piping, etc., be designed for easy component removal).
- ❑ Do electrical, piping and other systems allow for isolation of the separate components.
- ❑ Use bolted platform and bracing connections to facilitate temporary removal.
- ❑ Show all hoist hook limits on drawings.

Note: Normally any downtime for maintenance means a production loss or puts the operation at risk while the equipment is down.

Engineering Management and Planning

- ❑ Use the Project Scope as the basis to write an Engineering Scope of Work
- ❑ Define the drawing list, equipment list, and specification list and define the method for tracking progress.
- ❑ Define approval process and document distribution.
- ❑ Define the organization chart and communication flow. All communications are to be to one person, the project engineer/manager.
- ❑ Define the levels of completeness and checking required for each submittal phase.
- ❑ Define scope change procedures for the Engineer to follow.
- ❑ Determine drawing standards (size, cad, numbering, etc.).
- ❑ Define all costs, hourly, overhead, and reimbursable.
- ❑ Document all drawings of existing facilities given to consultant.
- ❑ Identify which portions of the design involve new technology or untested concepts. Clearly define responsibility with the consultant.
- ❑ Determine which portions of the design will require engineering calculations.
- ❑ Identify which disciplines must be involved in the design and the relative contribution of each including mechanical, electrical, and structural.
- ❑ Does the consultants' project manager have the right background for this job and the power to pull in resources if required?

Engineering Conceptual Review (Has the correct design been chosen?)

- ❑ Identify the choices the designer made to arrive at this design.
- ❑ Are the design choices consistent with the project scope and goals?
- ❑ Are the portions of the project that involve new technology properly substantiated?
- ❑ What portions of the design will require operations review or approval?
- ❑ Will the construction interface with operations?

Engineering Detailed Review (Is the chosen design correct?)

- ❑ Verify all dimensions, notes, and assumptions involving existing items
- ❑ Check drawing standards
- ❑ Interference check and headroom.
- ❑ Verify all equipment is shown accurately on the drawing with clearance requirements

- ❑ Are risks considered over the life of the facility and all affected groups considered?
- ❑ Are appropriate standards, codes, engineering practices used? Are deviations justified and documented?
- ❑ Decide what "factors of safety" will be used, document the logic

Calculations

- ❑ Does company policy affect the calculations?
- ❑ Are there applicable codes and regulations?
- ❑ Do the calculations follow good engineering practice?
- ❑ What are the assumptions in the design?
- ❑ What is the factor of safety?
- ❑ What duty cycle or service factor applies?
- ❑ What is the source of the information?
- ❑ How qualified is the designer?
- ❑ What is the accuracy of the data?
- ❑ Have the calculations been documented for future reference?

Drawings

- ❑ Does company policy affect the drawing?
- ❑ Has the drawing been checked and approved with proper signatures?
- ❑ Should the safety department review the drawing?
- ❑ Should an expert be consulted?
- ❑ Is the title block and drawing number the company standard?
- ❑ Is review by insurance company required?
- ❑ Are there applicable codes and regulations?
- ❑ Is a professional engineer's stamp required?
- ❑ Will there be an environmental impact?
- ❑ Does the drawing reflect good engineering practice?
- ❑ Is the drawing clear and easy to read?
- ❑ Are there standard symbols used?
- ❑ Is the drawing neatly drafted?
- ❑ Is there a complete set of references?
- ❑ Is there a bill of materials?
- ❑ Are all appropriate notes included?

Engineering Submittals Review

- ❑ Engineer's calculations
- ❑ Shop drawings
- ❑ Equipment drawings and specifications
- ❑ Construction specifications
- ❑ Vendor information

Engineering Scope Check

- ❑ Does the design still conform to the project scope in terms of function?
- ❑ Have items been added which were not included in the original cost estimate?
- ❑ Will the design choices that have been made affect the design or construction schedule?

Construction Scope of Work

- ❑ Write a Construction Scope based on the project scope and engineering scope, and include reference on the drawing sets.
- ❑ Is the construction or installation schedule driven or cost driven?
- ❑ Who will be doing the construction?
- ❑ Is the complexity of the design consistent with the labor force that will be involved?

Identify types of work involved, each one represents a potential subcontractor or department:

- ❑ Foundation
- ❑ Electrical
- ❑ Electronics – process instrumentation
- ❑ Concrete – Masonry
- ❑ Mechanical – HVAC
- ❑ Mechanical – process

- ❑ Optical
- ❑ Steel
- ❑ Roofing
- ❑ Piping - Plumbing
- ❑ Fencing
- ❑ Carpentry – framing, sheetrock
- ❑ Security systems, keys, and surveillance
- ❑ Information Services – instrumentation computer interfaces
- ❑ Others?

Will technical experts be required for certain portions of the job?

Define testing and Q. A. requirements:
- ❑ Identify the most probable construction sequence and perform build ability check.
- ❑ Interferences
- ❑ Interface with existing facilities
- ❑ Access
- ❑ Staging area

Equipment requirements:
- ❑ Identify impacts on ongoing operations and facilities.
- ❑ Structural - temporary structures or shoring
- ❑ Logistics - changes in traffic patterns
- ❑ Process - temporary changes to material or power flow due to connections or bypasses.
- ❑ Mechanical - isolation for dust, fume control, welding
- ❑ Safety - isolation of construction activities from normal operations.
- ❑ Emergency Response

Cost Estimate Considerations
- ❑ Access to site, roads, railroads, airports, docks
- ❑ Allowances for items not fully detailed in the cost estimate
- ❑ Archeological surveys
- ❑ Code compliance, OSHA, MSHA, NFPA, IBC, State, County, Local
- ❑ Commissioning and start-up costs
- ❑ Consultants
- ❑ Contingency (KEY ITEM that must be based on amount of Engineering done)
- ❑ Contract growth; 5-10%
- ❑ Controls (Environmental)
- ❑ Controls (Safety and Industrial Hygiene)
- ❑ Cost impact caused by modifications directed by governmental authorities
- ❑ Cost of purchased utilities during construction; water, electrical, etc.
- ❑ Currency exchange rate fluctuation
- ❑ Delays; schedule, transportation, fabrication, drawings, material availability
- ❑ Demolition; removal of existing materials or facilities
- ❑ Distributive Controls System or other software control systems (equipment to generate production - status reports)
- ❑ Drafting
- ❑ Engineering costs
- ❑ Environmental impact studies
- ❑ Environmental permitting
- ❑ Environmental review
- ❑ Environmental testing and monitoring
- ❑ Escalation; dependent on inflation, availability of material, location
- ❑ Expediting (trips to factories, outside expediting, inspections)
- ❑ Fencing or barricades
- ❑ Field fabrication shops
- ❑ Field office trailer
- ❑ Field site preparation
- ❑ Field storage trailers
- ❑ Final site clean up

- ❑ Finance charges and interest
- ❑ Fire protection for cooling towers, electrical installations, control rooms, etc.
- ❑ Freight; dependent on contract agreements
- ❑ Hazardous waste removal and containment
- ❑ Inspections (factory and field)
- ❑ Insurance (new coverage, project coverage, transportation)
- ❑ Interest on capital
- ❑ Janitorial needs (storage, supplies)
- ❑ Labor and materials (Company and Other)
- ❑ Labor (Overtime for engineering, fabrication, construction, start-up, etc.)
- ❑ Labor Laws
- ❑ Land acquisition and right of way costs
- ❑ Lay down areas, grading, signs, and fences
- ❑ Legal, cost of advisement, review, litigation
- ❑ Loss of production from interruption of tie-in's or interferences
- ❑ Major materials (bulks, major equipment)
- ❑ Major purchase orders (allow for purchase order growth)
- ❑ Man-hours (Construction, Engineering and Expediting)
- ❑ Manuals (Maintenance and Service, Operating and Training)
- ❑ Miscellaneous building/office accessories
- ❑ Modeling, process, ergonomic, mechanical
- ❑ Office: Clerical assistance, computers, miscellaneous equipment and supplies
- ❑ Penalties and incentives
- ❑ Permits and fees; Federal, State, County, Local)
- ❑ Process rights; licenses and royalties
- ❑ Project Management (Company and outside)
- ❑ Purchasing; labor, contracts
- ❑ Quality Assurance (Concrete testing, engineering controls, miscellaneous, soil test, and thickness tests, welding, NDT)
- ❑ Redundant equipment - backups
- ❑ Rental equipment; cranes, lifts, trucks, pumps, light plants
- ❑ Repair or modification of existing equipment
- ❑ Review each Engineering discipline (Architectural, civil, electrical, instrumentation, mechanical, piping, and structural)
- ❑ Safety equipment, personal, mechanical
- ❑ Salvage value of dismantled materials and facilities
- ❑ Schedule acceleration (shortening the schedule or getting back on track)
- ❑ Security; supervision, controls
- ❑ Signs, safety, process, instructional, nameplates, tags
- ❑ Spare parts (rule of thumb: 5% - 7% of mechanical equipment, electrical and others)
- ❑ Specialty work; code welding, optics, materials
- ❑ Studies required during construction
- ❑ Surveying
- ❑ Taxes: Contractor's Gross receipt; 3.0% of construction labor and materials, county excise; .5% of construction labor and materials, property if applicable, and sales if applicable
- ❑ Technical assistance; start up
- ❑ Temporary facilities
- ❑ Testing of equipment (performance testing)
- ❑ Training
- ❑ Transportation; trucks, rail, airlines, ships, special conditions helicopters
- ❑ Travel and living expenses
- ❑ Utilities (domestic and process water, electrical, fire water, gas, process gases and liquids, relocation of existing and new, sewers and steam and condensate)
- ❑ Vendor representative costs
- ❑ Warranty work
- ❑ Working capital

Scheduling Considerations

The following are why you need to add slack time to your schedule:

- ❑ Computer viruses

- ❑ Equipment/material lead time or back-order
- ❑ Shop drawings, errors, corrections, approvals
- ❑ Shop fabrication, errors, delays
- ❑ Equipment/material delivery delays
- ❑ Equipment/material delivery to wrong area
- ❑ Environmental studies or permitting
- ❑ Environmental extra requirements
- ❑ Permitting other than environmental
- ❑ Inclement weather - (rain, snow, winds, etc)
- ❑ Smoke - pollution
- ❑ Natural disaster - (flood, lightning, wildfire, dust storms, etc)
- ❑ Accidents, especially serious ones with injures or serious equipment damage
- ❑ Power or other utility failure
- ❑ Component failures
- ❑ Highway construction - other transportation problems
- ❑ Labor stoppages or slowdowns
- ❑ Holidays - loss of productivity around holidays
- ❑ Engineering resource availability
- ❑ Engineering errors and rework
- ❑ Poor plans and specifications
- ❑ Additions to scope of work
- ❑ Project submittal dates and review
- ❑ Release of funds and other approvals
- ❑ Multiple contract complications and interference
- ❑ Unclear contracts
- ❑ Communication problems
- ❑ Construction equipment availability - (e.g.: large cranes)
- ❑ Skilled craftsmen or other contractor resource availability
- ❑ Contractor over-all work load - other projects drawing resources
- ❑ Special safety requirements
- ❑ Poor supervision
- ❑ Poor productivity - poor craftsmanship
- ❑ Installing things wrong - corrective action
- ❑ Punch lists - warranty work
- ❑ Contractual penalties & incentives
- ❑ Litigation
- ❑ Serious safety infractions
- ❑ Public protest or interest
- ❑ Media
- ❑ Political considerations
- ❑ Travel restrictions
- ❑ Terrorist activities -Sabotage
- ❑ Military movements
- ❑ Changes in management structure or leadership

ITEMS TO WATCH FOR IN COST ACCOUNTING

- ❑ Determine type of contract - cost plus percent, cost plus fixed fee, firm bid with adds for scope changes, etc
- ❑ Determine ahead of time what are the critical cost centers
- ❑ Determine how you will forecast cost
- ❑ Recognize the fact and you will have unforeseen costs and allow for the accounting of these items. (i.e. Company labor, freight)
- ❑ Determine how you will track cost and which detailed costs need to be tracked
- ❑ Determine the number of work orders you feel will been necessary to easily manage your project. Too many can be cumbersome, not enough will not allow you to track costs easily
- ❑ When you set up your work orders, remember that you must be able to compare the costs with a budget of some sort. Without a comparison, throughout the project, the costs cannot tell you whether you are on budget or not. A comparison at the end of a project could be to late
- ❑ Whether you have a general contractor for project management to track project cost or not, a system is still needed to track and monitor their work. Having an outside contractor monitor your costs may be a duplication of effort.

- ❑ Determine if an Agency Agreement would be cost effective.
- ❑ Determine how and when to pay contractors, vendors, etc.
- ❑ Determine what and when cost reports are to be submitted to you.
- ❑ Determine how and when you will approve invoices, reports, etc.
- ❑ As with other items on large projects you may have an expert assist in this area.
- ❑ Develop headcount and labor hour accounting system.
- ❑ Develop material accounting system.
- ❑ The following items must be constantly tracked and reported:
- ❑ Original estimate
- ❑ Project amount authorized
- ❑ Committed cost
- ❑ Current actual cost
- ❑ Estimated cost to go
- ❑ Estimated final cost
- ❑ Write your purchase orders as soon as the contract has been signed.
- ❑ Notify the contractor/vendor of item numbers if there are multiple work orders on the purchase order. Accounts Payable cannot determine which work order to pay on without item numbers

ITEMS TO WATCH FOR IN PROCUREMENT

- ❑ Who will order material, company or outside contractor/engineering company?
- ❑ Who will receive material and at which Division, Contractor or Engineering Company, location etc.?
- ❑ Is the project material taxable or tax exempt?
- ❑ If exempt, will Company purchase or will contractor?
- ❑ Is an "Agency Agreement" practical?
- ❑ Will project involve a services contract?
- ❑ Does Company have an Annual Master Agreement with Contractor/Engineering Company?
- ❑ If not, allow time for contract terms and conditions to be negotiated.
- ❑ Be aware of exceptions to general contract conditions.
- ❑ Does the project or purchase order require merit and penalty clauses?
- ❑ Will the project be handled by a general contractor or with subcontractors, or will there be various contractors reporting to Company's project engineer?
- ❑ Contract bid analysis-spread sheets, evaluations and equalizations, recommendations, pros and cons.
- ❑ Contract type: firm bid, cost-plus; overtime costs negotiated before award and execution of contract.
- ❑ Contract changes of scope.
- ❑ Contract change orders.
- ❑ Purchase order bid analysis, spreadsheet, evaluations and equalizations, recommendations, pros and cons.
- ❑ Do material lead times coincide with project schedule?
- ❑ Purchase order terms and conditions, note exceptions.
- ❑ Purchase order freight terms, is additional insurance necessary?
- ❑ Long lead time items identified?
- ❑ Critical material identified?
- ❑ Do purchase order status reports coincide with project schedule?
- ❑ Engineered equipment: is supplier adhering to requests for manufacturing schedule, quality control criteria as identified, and other expediting requests?
- ❑ If schedule is accelerated, what additional charges will be incurred, i.e. expediting and transportation?
- ❑ Purchase order change order requests.
- ❑ Contract changes of scope.
- ❑ Contract change orders.
- ❑ Work performed to contract specifications.
- ❑ Calculations of penalties and bonuses if necessary.
- ❑ All materials received properly.
- ❑ All invoices processed timely.
- ❑ Has certificates of insurance been received?
- ❑ Equipment must meet all codes, OSHA, ANSI, MSHA, NEC, etc.

Guidelines for shop expediting trip

- ❑ Determine which Purchase Orders (P.O's) require expediting?
- ❑ Review Purchase Order list, every thing accounted for?
- ❑ Schedule the visit, do they know your coming?
- ❑ Bring your drawings and specifications.

- ❑ What additional technical expertise is needed, scientists, engineers, specialist, instrument makers, and/or shop personnel?
- ❑ What are the types of measurements needed and with what equipment?
- ❑ Is the testing equipment calibrated, if needed?
- ❑ When visiting vendors shop, be aware of their safety procedures, hazards.
- ❑ Photograph the equipment being manufactured.
- ❑ Review shop schedules, are they on track?
- ❑ How will they correct schedule if they fall behind?
- ❑ What are our contractual rights if delays occur, penalties or incentives?
- ❑ Are the shop priorities on our order; are there other contracts that may deter our schedule?
- ❑ Determine and identify long lead specialty equipment that may affect the schedule of project.
- ❑ Review and discuss delivery dates
- ❑ Review shop labor or FTE schedule, does it appear appropriate?
- ❑ Is overtime scheduled or weekend work, why?
- ❑ Insist on viewing received materials and work in process.
- ❑ Note housekeeping and quality control procedures.
- ❑ Check newly fabricated equipment for hazards that may not be apparent on design drawings.
- ❑ Are guards on moving parts?
- ❑ Are operator controls in safe positions?
- ❑ Does it appear that the shop is complying with local regulations?

Safety items to watch for in Procurement

- ❑ Are materials hazardous or toxic, like flammable, explosive, corrosive, radioactive, and carcinogenic?
- ❑ Do the materials require special handling? Containers (plastic, glass)?
- ❑ Do material require special transportation (truck/rail/air)?
- ❑ How will the material be stored once received (freeze protection, rain cover)?
- ❑ Is a material safety data sheet available for the material? Get them and file.
- ❑ What is the physical size and weight of the equipment being shipped?
- ❑ Does equipment received require special loading and unloading like cranes and/or rigging? Is there a crew available?
- ❑ Will the equipment fit into the space it is to be stored and allow access - blocked exits, hidden fire extinguishers?
- ❑ Request certified dimensional drawings before receiving.
- ❑ Request operating manuals for safe operating procedures and safety precautions.
- ❑ Are guards to be supplied for exposed moving parts or electrical components?
- ❑ Is a safety shutoff required?
- ❑ Bids must include the cost of supplying safety equipment not specifically supplied by Company. See Things to Cover in the Pre- Construction Bidding Meeting.

CONSTRUCTION

The project manager/engineer is responsible for all aspects of the construction phase including: Safety and environmental compliance, cost control, the schedule, field engineering, field supervision and coordination. Quality control and assurance, contract administration, procurement, expediting, labor and human relations, preoperational testing, training, commissioning and everything else.

Items to Address in the Pre-Construction Bidding Meeting

- ❑ Ensure that all bidders are present.
- ❑ Review meeting purpose and agenda.
- ❑ All parties get copies of the correspondence related to the project, like details, change in materials
- ❑ Reports - What reports are required? How often? What is in the report? Who issues them? Who gets them?
- ❑ Establish who the authorized representatives are for both parties and who has signing authority.
- ❑ Review the construction scope of the work in detail and make sure all parties understand and are in full agreement.
- ❑ Review the contractual terms and conditions and once again establish the contractors understanding and agreement.
- ❑ Discuss how scope of work changes will be handled, who can approve, nobody does any extra work without proper approvals.
- ❑ Construction problems are to be brought to Company's project manager immediately.

- ❑ Agree to construction superintendent (after careful review of his work experience) and get agreement that he cannot be replaced unless approved by the Company in writing.
- ❑ Ensure all parties know what materials are Company supplied and what materials are contractor supplied.
- ❑ Review the project organization.
- ❑ Ensure everyone knows who the contacts are for each party and their roles. Establish line of communication and correspondence.
- ❑ Establish a contact with operations and maintenance.
- ❑ Set up time and place for weekly meetings if project warrants.
- ❑ Ensure contractors know the type of support that will be provided by the Company.
- ❑ Ensure everyone knows the start date of the construction phase, schedule and finish date
- ❑ Establish the critical path and formally approve the schedule.
- ❑ Discuss the hours to be worked and days to be worked
- ❑ Will there be a requirement for contractor's safety performance and assessment for the contract is to be let
- ❑ Review the contractor's safety performance report (assessment)
- ❑ Ensure that contractors have their own safety program, request copies for review
- ❑ Ensure that the contractor has a designated safety representative
- ❑ Contractor to furnish their own safety equipment except those items the Company agrees to furnish
- ❑ Review insurance requirements; no contractor on site without a certificate of insurance.
- ❑ Review safety regulations and procedures (e.g. accidents) and emergency phone numbers (e.g. ambulance).
- ❑ Incidence reports must be filed by the contractor and reviewed by the Company.
- ❑ Contractor shall maintain accurate accident and injury report and furnish weekly summary of injuries and person-hours due to injuries
- ❑ Contractor to maintain first aid facilities at site?
- ❑ Contractor must be aware of working conditions, traffic, blasting, moving production equipment, dusty or gassy atmospheres, limited visibility, Hot atmosphere, confined working spaces
- ❑ Location of emergency facilities, first aid, hospital
- ❑ How to call for help in case of emergency - radios?
- ❑ Vehicle requirements, right of way, seat belts required, vehicle flags
- ❑ Procedures for lockout of equipment - mechanical, electrical
- ❑ Get contractor MSHA number or other certifications if required.
- ❑ Ensure that the contractor has current inspection papers on all equipment.
- ❑ Review contractor's safe rigging practices
- ❑ Who provides security? Does contractor have their security or will the Company provide?
- ❑ How do we enforce security - Company/Contractor?
- ❑ Establish the access procedure.
- ❑ Outline area(s) that work will occur to avoid interference with operations or impact on operations.
- ❑ Outline parking areas for contractors.
- ❑ Establish material lay down areas.
- ❑ Review utilities and who furnishes and where the tie in's are.
- ❑ Review what large equipment the contractor will have on site.
- ❑ Address restrooms and change rooms
- ❑ Special issues relating to work on Kitt Peak - preference to Native American firms, TERO compliance and communication, fees
- ❑ NSF approval process if over $250K; additional requirements for awards of $1M and more
- ❑ Davis Bacon prevailing wage clarification at the inception of the contract. The rates have recently changed substantially and need to be clarified as early as possible.

Note: Minutes of the pre-award and pre-construction meetings should be included in the contract.

After Award Pre-Construction Meeting Checklist

- ❑ Review construction scope of work
- ❑ Review in detail the safety portion of contract
- ❑ Clearly define contractor's safety responsibilities
- ❑ Verify time and place for safety meetings?
- ❑ Company project manager and engineer(s) to periodically attend contractor's safety meetings
- ❑ Contractor to immediately correct unsafe conditions and unsafe acts
- ❑ Determine who is the contractor's designated safety representative
- ❑ Contractor's safety personnel shall be adequately trained and licensed if required by law
- ❑ Contractor shall provide MSHA certificate or other certifications if required
- ❑ Contractor to comply with all safety rules and regulations, codes, etc. i.e. OSHA, MSHA, State Mine

Inspector, etc.
- ❑ Review in detail fire protection portion of contract
- ❑ No fires or burning of material at job site
- ❑ Fire watches where necessary, burning and welding
- ❑ Proper identification and location of flammable materials?
- ❑ Adequate fire extinguishing equipment?
- ❑ Review evacuation and emergency procedures
- ❑ Review explosive section of contract if applies
- ❑ Review illumination section of contract
- ❑ Review site condition section of contract
- ❑ Review environmental conditions of contract
- ❑ Review waste disposal section of contract
- ❑ Review housekeeping portion of contract
- ❑ Contractors equipment must be safe, certified and licensed, etc. where necessary
- ❑ Pass out any forms that are to be used on the job
- ❑ Review ambulance and fire trucks procedures
- ❑ Review phone numbers of various people; guard gate, Company safety representative
- ❑ Provide keys

Items to Watch During Construction

- ❑ Daily contractor log/reports, written by the Company contract administrator.
- ❑ Contractor notice of readiness for inspection forms
- ❑ Contractor's schedules - continuous updates. Make sure you formally approve the schedule submitted by the contractor.
- ❑ Key equipment - know status
- ❑ Key personnel - know situation
- ❑ Safety procedures and safe work procedures - first aid, safety regulations. Ensure the contractor conducts weekly safety meetings and documents them. Safety must be PROACTIVE.
- ❑ Lay down areas demarcated? Is the plan being followed?
- ❑ Utilities properly installed (permanent and temporary)?
- ❑ Restrooms - follow-up
- ❑ Work hours - overtime hours
- ❑ Organization - responsibilities - follow-up
- ❑ Daily inspection of work
- ❑ Daily meeting with contractor or individual contractors
- ❑ Ensure reporting is done on timely basis
- ❑ Field engineering work, are there major changes?
- ❑ Constant review of schedule - including a detailed 2-week look ahead schedule. Have a meeting each week to briefly review the schedule as well as any other outstanding issues.
- ❑ Expert inspections, Quality assurance, Vendor assistance
- ❑ What testing is required? - X-ray, soil, concrete
- ❑ Establish a project punch list and completion procedure.
- ❑ Make sure you get your as built drawings prior to release of final payment.
- ❑ Who does cold commissioning of equipment? Establish a pre-op sequence test schedule.
- ❑ Who does hot commissioning?
- ❑ What type of construction back-up team do you keep during commission and start-up?
- ❑ Site security needed? Are they visible?
- ❑ Keep combustible and flammable materials out of buildings until fire protection is installed
- ❑ Establish trash areas away from construction and schedule frequent trash removal to prevent fire hazards
- ❑ Temporary (framed) structures should be well away from construction
- ❑ Provide temporary fire protection equipment during hazardous construction
- ❑ Implement Hot Work Permitting Program
- ❑ Use only flame resistant tarps for protecting equipment and facilities
- ❑ No "home made" heaters
- ❑ Bulk storage for flammables outside of buildings, no more than one days use in buildings
- ❑ Only approved containers for flammables
- ❑ Stage areas away from construction for fueling vehicles and gas driven machinery
- ❑ Provisions made for high winds or extreme temperatures?

Construction Contractor(s) Initial Site Visit

- ❑ Walk through construction site with the contractor's supervision
- ❑ Walk through lay down areas
- ❑ Walk through construction office areas
- ❑ Point out emergency doors and door numbers
- ❑ Point out fire extinguishers and location
- ❑ Point out fire hydrants
- ❑ Show contractor location of first aid stations, dispensaries and hospital.
- ❑ Show contractor location of fire station
- ❑ Show the contractor the project office location
- ❑ Show contractor location of Company safety office
- ❑ Show contractor location of Main Gate or entrance
- ❑ Show the contractor the security office
- ❑ Point out safety hazards in job area
- ❑ Point out power lines and cables
- ❑ Location of items to be locked out and tagged out
- ❑ Traffic, trains, cranes, vehicles, industrial vehicles, etc.
- ❑ Process hazards like cryogenics, chemical lines, hot metal, steam lines, dust, chemical vats etc
- ❑ Review "off limit" areas
- ❑ Reiterate safety policies and expectations

Construction Safety Meetings

- ❑ Ensure regular safety meetings
- ❑ What day?
- ❑ How often are they held?
- ❑ Where are they held?
- ❑ What time are they held?
- ❑ How long?
- ❑ What will be covered, are the subjects appropriate or just filler?
- ❑ Are the subjects tied to the "days" activities?
- ❑ Is there a company representative present at the contractor's safety meeting, (not giving it)?
- ❑ Are minutes of safety meeting taken by contractor and are they recorded and filed?

Construction Site Inspection Sample Checklist

- ❑ Is the contractor safety person, responsible? Is there an inspection form?
- ❑ Minutes of jobsite safety meetings recorded and kept at jobsite?
- ❑ Are certified Physicians, paramedics, EMT's, or first aid personnel on the job?
- ❑ Approved and stocked first aid kits and medical equipment on job?
- ❑ Hearing protective devices provided for and worn by workers where noise levels are excessive?
- ❑ Hard hats and safety glasses provided for and worn by workers when needed?
- ❑ Additional eye and face protection provided for and worn by workers where exposed to potential eye or face injury?
- ❑ Workers required to wear footwear adequate for their assigned work?
- ❑ Respiratory protective equipment provided and worn when workers are exposed to harmful dusts, fumes, gases?
- ❑ In areas where flammables are stored or where operations present a fire hazard, are "NO Smoking or "Open Flame" signs posted?
- ❑ Fuel containers posted and identified?
- ❑ Forming and scrap lumber and all other debris kept clear from work areas?
- ❑ Combustible scrap and debris removed from work areas at regular intervals?
- ❑ Containers provided for collection, separation of waste, trash, oily and used rags?
- ❑ Solvent waste, oily rags, and flammable liquids kept in locked fire resistant covered containers until removed from worksite?
- ❑ Is portable fire-fighting equipment available, properly located, and maintained? Inspection tags up to date?
- ❑ Hand held powered tools (saws, air impact) equipped with guards and ONLY with constant pressure switch?
- ❑ Air hose connections secured?
- ❑ Power actuated tools provided with safety shield/guard and operator has evidence of special training in their use?
- ❑ Portable power circular saws provided with proper functioning automatic return, lower guard, and fixed upper guard?

- ❑ Are exposed or concealed power circuits warning sign posted and are all workers advised of the hazards where accidental contact by tools/equipment may occur?
- ❑ Are ladders regularly inspected and destroyed when found defective?
- ❑ Side rails extended 36" above landing or provision of grab rails?
- ❑ No metal ladders used within 15 feet of electrical lines?
- ❑ All open sides and ends of platforms more than 10' above ground or floor level, provided with top rails (42" high), midrails, toe boards (4" high)?
- ❑ Where workers pass or work under scaffolds are there screens or other overhead protection provided?
- ❑ Platform planks laid together tight preventing tools and equipment from falling through?
- ❑ Work level 10' or more above ground floor level have guardrails and toe boards?
- ❑ All cross and diagonal bracing in place and properly connected?
- ❑ Load limit marked on each scaffold?
- ❑ Each employee equipped with safety harness and attached to lifeline?
- ❑ Power cables for electric hoist machines secured to platform to prevent snagging between power supply joint and platform?
- ❑ Approved canopy guards on forklift trucks and rollover protection on all earth moving equipment?
- ❑ Rated capacity posted on all lifting, hoisting equipment clearly visible to the operator?
- ❑ Where mobile cranes are regularly used, daily inspections made of critical items and records kept?
- ❑ Annual inspection made of crane hoisting machinery and record kept of dates and results?
- ❑ On tower cranes, weekly inspections made of supporting parts, safety appliances and record kept of repairs required?
- ❑ No part of crane or its load closer to energized electrical lines than 15'?
- ❑ Excavated material effectively stored and retained at least 2' or more from edge of excavations and trenches?
- ❑ Trenches more than 5' in depth shored to standard, laid back to stable slopes or provided with other equivalent protection where hazard of moving ground exists?
- ❑ Proper personal protective equipment provided, in good condition and being used?
- ❑ All oxygen and fuel gas cylinders secured properly, in upright position?
- ❑ Oxygen and fuel gas cylinder stored in upright position in designated areas with caps in place?
- ❑ Oxygen stored 20' from fuel gas cylinders?
- ❑ Electric arc welding cables in good condition and properly attached by lugs to welding machine?
- ❑ Welders' shields and helpers' goggles in good condition and equipped with proper lenses?
- ❑ Fire extinguishers provided within 25' of welding, cutting or burning operations?
- ❑ All welding cable positioned to eliminate tripping hazards?
- ❑ Dust controlled by wetting?
- ❑ Employees provided with dust respirators and goggles?
- ❑ Floor openings protected? If covered are they secured?

Construction Safety Punch List or Observation Checklist

- ❑ Maintain safety punch list throughout job - the unsafe actions or unsafe conditions are to be brought to contractor supervision's immediate attention.
- ❑ The safety punch list should include date when unsafe act or condition was found and date corrected.

Construction Final Site Inspection

- ❑ Was "it" constructed per the scope of work?
- ❑ Is lighting adequate?
- ❑ Is final housekeeping completed?
- ❑ Is all hazardous and flammable material removed and disposed of properly?
- ❑ Is all fire protection equipment in place?
- ❑ Are all safety signs hung?
- ❑ Are ladders and platforms correctly installed and meet codes?
- ❑ Are all electrical wires, cables and equipment devices correctly installed and meet all codes?
- ❑ Any new hazards noted?

SAFETY ITEMS RELATED TO TRAINING

- ❑ What operating and maintenance manuals will be written? Is safety included in the manuals?
- ❑ Is special safety training required because of new hazards?
- ❑ Should special classes and classrooms be set up?
- ❑ How will field training incorporate safety issues?
- ❑ Is factory safety training available?

- ❑ Should the safety department incorporate special training in new employee training?
- ❑ Is there specific OSHA type tasks training required?

    - Crane safety
    - Excavation
    - Mobile equipment
    - Confined space
    - Hazardous Materials Handling
    - Exposure to chemicals
    - Compressed gasses
    - Flammable liquids
    - Fall Protection
    - Steel erection
    - Cutting burning and welding
    - Scaffolds
    - Suspended workloads
    - Temperature extremes
    - Altitude
    - Sources of Fumes
    - Hydraulic systems
    - Explosives
    - Explosive Actuated tools
    - Radiation
    - Painting
    - Rotating and moving parts
    - Robotics
    - Control of Hazardous Energy
    - Rigging
    - Ventilation
    - Sanitary Facilities
    - Fire and Evacuation Procedures
    - Alarms, Sirens, Horns and Flashing Lights
    - Restricted Area
    - PPE
    - Traffic patterns and speed
    - Process hazards

ITEMS RELATING TO COMMISSIONING/START-UP

- ❑ Safety is of prime importance during this period!
- ❑ Who is responsible for start-up?
- ❑ Who schedules and coordinates?
- ❑ Is the project large enough to require start-up packages and start-up the different areas at different times?
- ❑ Determine when start-up meetings are held - once/day or twice/day
- ❑ Who attends start-up meetings?
- ❑ Are all involved personnel adequately informed of hazards?
- ❑ Does every one have the right procedures?
- ❑ Is there a detailed schedule?
- ❑ Is start-up done in phases - cold commissioning and hot commissioning?
- ❑ What does the organization look like?
- ❑ What support groups are needed?
- ❑ What vendor expertise is needed?
- ❑ Are safety interlocks bypassed? If so, what special precautions have been taken?
- ❑ Does the commissioning adequately include all safety related issues?
- ❑ Have all involved personnel been trained?
- ❑ Are critical risks protected?
- ❑ Does everyone know what they are doing?
- ❑ Is the communications system adequate?
- ❑ Are emergency procedures developed?

ITEMS TO ADDRESS IN THE PROJECT COMPLETION MEETING

- ❑ Record results of the meeting for the final report
- ❑ Discuss project safety results and objectives
- ❑ Discuss and record things learned
- ❑ Review things engineering department could have done to have improved the project
- ❑ Review things operation department could have done to have improved the project
- ❑ Review project organization, was it adequate?
- ❑ Review costs
- ❑ Review schedules
- ❑ Review document distribution, was it adequate?
- ❑ Was communications good?
- ❑ How could have overall project been done better, faster, and at lower cost?
- ❑ Discuss project highlights, things done right?
- ❑ Discuss main problems encountered in project.
- ❑ Were project monitoring and control methods acceptable?