Engineering Management
Field Project

Electronic Construction Coordination with AutoCAD

By

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Executive Summary

A key component to the construction process is drawing coordination. Due to the fast paced nature of today's construction, many design firms utilize other consultants to aid in completion of the documents within the required design time frame. Coordination between consultants is often neglected as the design is completed. Additionally, traditional coordination methods utilize hard copies and light tables for coordination of construction drawings. Therefore, it is desirable to create an improvement plan that utilizes electronic coordination for the construction process.

Modifying the coordination process to a soft format that utilizes AutoCAD design software would improve quality and accuracy. The improvement plan also included changes to the bid process and job buyout. Shop drawing development was required to be completed utilizing zone and layer control. Drawing guidelines were developed to simplify compiling of multiple files into a single drawing.

A key aspect of this project was document management. Files were produced using specified layer control, labeling requirements, and drawing standards. A third party was hired to manage an FTP site for storage and movement of files. This system ensured the current files were available for use and the older files were archived.

The construction coordination process requires three stages, drawing coordination, field coordination, and as-built development. The majority of coordination is completed during the drawing coordination stage. Field coordination is utilized to correct for errors and problems created by overlapping tolerances and installation errors. The work in place is then documented to insure the drawings are updated to provide accurate as-built drawings for the client.

The program provided improvements to the existing system and achieved a basic level of soft format coordination. This system improved speed, lower costs, and allowed

individual sketches of specific items to be produced for review. The use of layer control allowed for plots to be produced showing only the layers critical to the specified application. This uncluttered the view and made a more useful drawing.

The information learned from implementing this process has identified areas that should be improved prior to repeating the process. Additional time should be devoted to training participants in the use of the available resources, labeling conventions, naming conventions, and drawing standards. Other areas that created problems were inconsistency in the drawing packages and third-party plug-ins used by subcontractors. Further investigation identified many of the plug-ins were required to support their shop manufacturing processes and could not be eliminated.

Further work would be to use the information gained during this project for improvement of the implementation of a Building Information Management (BIM) system. The architectural design packages are currently set for developing drawings in 3D. The BIM system adds a database of critical component information which is packaged with the drawing. The mechanical and electrical trades have not adapted the new formats for design at this time. The mechanical and electrical software designers are still in work on development of the BIM design packages. Once this step is complete, the program will contain all critical parts to being a fully operation system.

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Construction Definitions & Roles

As-Builts – are a record set of drawings that show the actual installation of the work. These drawings are not finalized until after the work in completed. To maintain accuracy, the coordinated drawings must be updated to show variations as the work is installed. The intermediate step is called “red lines”.

Column Lines – is a grid system in construction documents to aid in the ability to identify a specific location on the drawings or in the field. One access utilizes letters and the other utilizes numbers. There is a consistent spacing between each line. An example would be C17. This represents C on the x-axis, and 17 on the y-axis.

Conceptual Design – is the first design produced. It attempts to provide a general description of the project. The intent is to allow the client to get an initial view of the designers understanding of the project.

Design Build – is when the owner holds a single contract with a company who is responsible for both design and construction of the project. The Architects, Engineers, and Construction Management are all considered to be the same team from the view of the client. In many cases, the team is a joint venture between companies that specialized in each area.

Detailed Design – This design incorporates all necessary information for construction of the project. It is produced by the Architect and utilized by the Construction Manager for bidding and awarding the work. This document is the basis for the subcontracts.

Document Management – is the system used to manage and control the distribution and archival of the construction drawings, RFIs, addendums, contracts, correspondence, etc. Most

projects require a system for managing soft and hard copies. The system must also provide a method for correlating the two systems.

Drawing Coordination – is the process of resolving any conflicts between the individual trade shop drawings. This process is completed prior to the work being installed. The intent is to prevent rework from conflicts found during installation.

Drawing Standards – this is a guideline produced to insure all designers are producing documents in the same manner. These standards will define things such as scale, labeling, units, call-outs, details, fonts, text, layers, etc.

Fast Track Construction – is the system where construction begins prior to completion of the construction documents. The early packages are released for construction based on current information available, assumptions of future requirements, and experience from similar projects. The goal is to shorten the project duration to accelerate the completion date.

HVAC – Is the abbreviation for heating ventilation and air conditioning. This term is commonly used to describe the contractor or tradesman that installs these systems.

Job Buyout – is the process of hiring subcontractors to complete specific portions of the project. The process defines the work and compensation for the work. A contract is produced to document the agreement.

Labeling Convention – is the system for providing documentation to the drawings. This system must be defined to insure consistency between drawings from different trades.

Layer Control – AutoCAD documents utilize multiple layers to manage the large amount of information. To control the visible information, the names and organization of these layers

must be controlled. To allow the files of multiple trades to be combined, the systems and methods used must be consistent.

Light Table Coordination - is the traditional method of coordination between multiple trade shop drawings. The light table has lights below a transparent work surface. When two or more drawings are placed on the work surface with the light energized, the lines from the lower drawings will be visible through the top drawing. The drawing is reviewed for locations where the lines intersect. These areas are then checked to see if a conflict exists. The process is inefficient because the drawings are produced in 2D. It is possible for the lines to intersect without a conflict since the items could be at different elevations. Every intersection must be manually reviewed.

Schematic Design - is a preliminary design that establishes scope and relationships of the systems. The client's expectations are defined and reviewed. An initial budget and schedule is created to verify compliance with the funds available. This design does not provide adequate detail for construction.

Scope Creep – is when the design gradually implements small changes that combine to make a major impact on the scope and cost of the project. The results of scope creep are usually a design that far exceeds the actual needs of the program.

Scrubbed Backgrounds – are drawings that have had all extraneous information removed. For coordination, unnecessary information clutters the drawings when compiled. A few examples of things that would be removed are, drawing notes, title blocks, revision identifiers, and site reference diagrams.

Shop Drawings – drawings produced by the subcontractors depicting their understanding and interpretation of the contract drawings. These drawings expand all drawings dimensions to the correct scale. These drawings may be produced in 2D or 3D depending on the system and abilities of the subcontractor. These drawings are submitted to the Architect or Engineers for review to verify the correct understanding of the work. Once approved during the review process, these drawing are the basis for the coordination process.

X-Ref (External Reference) – items that are required to be the same for all drawings are incorporated into the drawing as an external reference. An X-Ref is a pointer to a separate file that contains this information. The benefit of using X-Refs is that changes are universal to all drawings. Some items typically included in the X-Ref files are column lines, title blocks, wall layouts, and site elevation references.

Zone Control – when designing a building, each trade should be assigned spaces for the system to be installed. These spaces are called zones. The intent is to prevent overlapping these zones. If zones overlap, there is potential for a conflict between the systems in each zone. It is common for there to be areas where overlapping the zones is unavoidable.

Role of Participants

Client

The client is the owner of the project. They hire the Architect and Construction Manager. If the client chooses to simplify or reduce their required interaction, they may have either the Architect hire the Construction Manager or the Construction Manager hires the Architect. This will allow them to have a single point of contact and avoid problems between

the two groups. In most cases the client will contract directly with each to provide a means of checks and balances.

The design is dependent on interaction between the client and consultants. The information provided by the client provides direction for the design. Throughout the design process, the client should have an opportunity to review the progress and adjust the direction and scope if necessary. The client has ultimate authority in any conflicts between groups.

Architect

The Architect works directly for the client. They are responsible for the design of the project. The final design is produced through a multiple step process. Each step is reviewed with the Client to insure it meets intent and budget. The Architect may produce all work with their personnel or may hire consultants to complete portions of the design. When consultants are used, the consultant delivers all information to the Architect who compiles it into the construction documents. The Architect is responsible for the review of all shop drawings to insure they meet the design intent.

Engineer

The Engineering Firm designs specific portions of the project as defined by the Architect. Engineering companies are typically used to complete the mechanical, electrical, and plumbing design. The documents produced by the Engineering Firm are delivered to the Architect for incorporation into the design documents.

Engineering firms are also used as consultants for specialized systems. Depending on the size of the system and amount of documents required to be produced, the firm might not produce any design documents. In this situation, they only provide suggestions or

recommendations to the entity producing the design documents. An example would be the layout of speakers for the public address portion of the fire alarm system. The consultant provides recommendations to achieve proper coverage, but the design is produced by the engineer designing the fire alarm system.

Construction Manager

The Construction Manager (CM) is hired by the client to insure that construction is completed on time and within budget. The firm is expected to act in the client's best interest. The CM is most effective when they are selected early and included through the entire project. During the conceptual design phase the CM provides valuable feedback on construction issues, such as site conditions, permits, labor issues, and contractor prequalification. Budgets are also established based on initial design information and historical data. As the design is refined, the estimates and schedule are updated to reflect changes and provide a more accurate estimate of project costs and schedule. This is essential to minimize scope creep.

During the construction phase, the CM controls the information flow between all participants. This includes the client, architect, engineering firms, specialty consultants, subcontractors, and vendors. They review construction progress and budgets to insure they are staying within the specified guidelines. The CM is responsible for review of the coordination drawings. Upon completion of the project, the CM insures all close out and record documentation is completed.

Subcontractor

The subcontractors are the firms that perform the work. They can be hired by the Construction Manager or directly by the Client. To transfer liability, the client typically has the

CM hire the subcontractors. This allows the client to have a single contract with the CM that provides grantees of performance and costs of the subcontractors as a whole.

Each subcontractor is hired to perform a specific scope of work. The subcontractor is required to produce all shop drawings and coordinated drawings associated with this work.

Vendor

The vendor is hired by the subcontractor to provide materials and equipment for the project. The list of acceptable vendors is typically created by the Architect and included in the specifications. The vendor provides cut sheets and detailed product drawings for the equipment they will be providing. The cut sheets detail the space and services required by the equipment. In addition, and service and access requirements are outlined. This information is incorporated into the drawings as they are transformed from shop drawings to coordination drawings.

Explanation of Construction Design Procedures

The construction design for this project is completed in 6 steps. The initial 3 steps are completed by the architects and engineers. The second 3 steps are completed by the subcontractors. The following chart shows the flow of the process.

The **conceptual drawings** are produced by the architect based on early conversations with the client. This step usually does not incorporate input from the engineering firm or the

construction manager. Owner comments and requested revisions are not incorporated until the schematic drawings are produced.

The **schematic drawings** incorporate input from the engineering firm and other consultants hired by the architect and owner. These drawings are revised and re-issued until the client accepts the design and releases the architect to produce detailed drawings.

The **detail drawings** provide the full design intent. The architect, engineer, consultant, and construction manager provide feedback for improving the quality of these documents. They are utilized for bidding the work. Once the work is bid and contracts awarded, these drawings become the "contract documents." Any changes to the design from this point forward require a modification to the contracts.

The **shop drawings** are produced by the contractors awarded the package to complete the work. The intent of the drawing is for the contractor to demonstrate their understanding of the design while incorporating the specified product data. These drawings must accurately show equipment dimensions, access spaces, code required clearances, interactions with other systems, and adjustment for constructability. The drawings are initially reviewed by the construction manager. Upon acceptance, the shop drawings are forwarded to the architect / engineer team for approval.

The **coordination drawings** are produced by the subcontractor after the individual shop drawings are approved by the architect / engineer. These drawings are reviewed by the construction manager. Upon approval, each contractor is required to sign the drawing sheets agreeing the layout will work in harmony with their work. The coordinated drawings are not reviewed by the architect / engineer.

The **as-built** drawings provide a record of the actual installation of the work. The drawings are produced by each contractor and forwarded to the architect through the construction manager. The architect converts the as-built to the clients preferred format for archival and future maintenance.

The focus of this project was to improve the coordination drawing stage of the process. In addition to changes to the coordination stage, accomplishing this task required modifications to the previous step of producing shop drawings as well as modifications to the following step of developing as-built drawings.

Literature Review

A literature review was completed to find previous research on the use of AutoCAD as a coordination tool and study Agile Project Management (APM). There was no information available on other projects that have used the AutoCAD software in the same manner intended for this project, however there was a large about of information providing guidance of implementing APM.

During the AutoCAD research, the search criteria was expanded to include information on the use of AutoCAD as a design tool and was further expanded to research its use in a multiple consultant environment. The resource list remained limited and nonspecific to the desired topic.

Background of development of AutoCAD

AutoCAD is a three dimensional design software package developed by Autodesk. The first version was released in 1982. In the past 25 years, there have been 21 major revisions. John Walker, the founder of Autodesk, has published the online book , *"The AutoCAD File"* providing the history of the development of AutoCAD and his visions for future improvements.

The key feature for coordination utilizing AutoCAD is the ability to create drawings in 3D. The initial plans to implement 3D design were introduced in 1983. This vision lead to the incorporation of the x,y.z axis on the work space. The early versions of

the software did not actually draw in three dimensions. The program was only capable of producing a two dimension drawing, that mimic the appearance of a 3D drawing observed from a single view. For each view that was required, a new drawing would have to be created. The document outlines the numerous steps required to develop the tools required to move from the initial 3D attempts to the current true 3D revision. This development background included in the text will provide a better understanding of the design of the user interface and software engine powering the software.

Agile Project Management

A key component to success for this project is managing the changes that must be implemented. The construction environment changes quickly and often. The management system must be capable of reacting at the same pace. The solution is developing an Agile Project Management system. Although this project appears to be an improvement to a construction process, the core changes to the systems are actually software development and project management improvements.

The Pace Systems manual published in 2003, “Agile Project Management” by Sanjiv Augustine and Susan Woodcock was reviewed. This manual identifies the keys to a successful implementation of APM. The key sections are the definitions of the 6 factors that must be incorporated for a successful implementation. The optimal use of this document would be to provide a basic understanding of APM to the project team as well as guidance on the operation and procedures. Even though it was based on software development systems, the guidance provided is universal to all APM systems.

The international Journal of Agile Management published the article, “Web-based Information Access for Agile Management” in 2000. The transition from traditional systems of data management to use of internet and extranet is explained. In addition to developing new systems to optimize the data management process, it is necessary to maintain compatibility with legacy systems and information. The default solution is to develop backwards compatible applications. This method can limit the capabilities of the new system. An alternate solution is to build new systems independent of concerns of maintain compatibility with older systems and utilize stand alone applications to convert older data to a compatible format. Numerous other options for utilizing web based systems for document control and distribution are also defined. Most applications are only compatible with a very small selection of these alternate options. The descriptions included provide a general overview requiring additional research prior to implementation.

A detailed explanation of the required employee involvement is outlined in, “Importance of Employee Involvement in World-Class Agile Management Systems” written by Yaw Owusu in 1999. Teams should be formed with the intent to improve the system they will work within. Beyond selecting team members, the proper team management skills should be used to optimize the results. This optimization requires proactive management involvement and strong two way communication. The author provides numerous recommendations that would require a significant amount of commitment from all levels of the organization throughout the duration of the project. The article does not address methods to motivate employees to abandon traditional

methods for the new concepts. It suggests that good communication will suffice but does not provide supporting information.

Agile Project Management Summary

There are 6 factors that must be incorporated for a successful implementation. The first is establishing clear guidance. All participants should know the goals of the project and understand the leadership's vision. As the process evolves, adjustment to these goals must be disseminated to all participants. Since the leadership cannot be all places at once, it is important the other team members understand the leadership's intent to allow continued adjustments to the changing environment.

Teamwork and collaboration are required to optimize the results. Each team member brings unique skills and perspectives to the project. By leveraging these resources, the output will exceed the total of the individual contributions. Attitude plays a significant role in the performance of the team. When the team members enjoy working together, the work product improves.

Rules are necessary for the smooth operation of the team. These rules should be kept as simple as possible to provide maximum flexibility. The character of the team will develop more complex behavior specific to the requirements over time. Keeping the rules simple will allow this complex behavior to evolve with the project without limitations.

Continuous distribution of the information is critical for supporting a system of constant change. The team can only respond and adapt to the information available to them. Open communication must be established and maintained. All members should be informed of the big picture.

Only enough control to maintain order should be implemented. Having to much control limits the effectiveness of the team. The leadership should focus on keeping the project heading in the right direction by not controlling individual activities. Whenever possible, provide the maximum latitude to team members to accomplish tasks.

The final step is to monitor the results and adjust the system as necessary. This should be done by team members as well as team leaders. Any participant should have the ability to recommend a change. Ideas that produce positive results should be expanded while the concepts that don't work should be revised. This is an ongoing process which lasts for the entire duration of the project.

Introduction

Drawing coordination is a critical component during the industrial construction process. Traditionally, the majority of this process would be completed by the design firm. These firms would develop and implement zone control for the different trades within the space available as part of the design process. When the drawings were issued for construction, they were adequate for use in constructing the project.

The need for a faster pace of construction to maintain market competitiveness has changed this process. To expedite the design process, the design firm develops a set of assumptions for the requirements of the structure. Basic requirements and minimal zone control is included as part of the design directive. These assumptions and criteria are sent to multiple design groups for concurrent completion of the design. Since all designers are working independently and assumed to be maintaining the criteria established initially, additional coordination is deferred until the construction phase.

During the design phase, additional information is obtained through client feedback or design development. Each consultant is expected to incorporate these modifications as the design documents are developed. It is assumed this implementation continues to maintain the initial requirements and zones. The final step

is to compile each consultant's documents into a print package to be issued for bid or construction.

The flaw with this system is the individual packages from each consultant are never compiled into the same drawing. To provide a similar appearance, the packages utilize the same initial background. When the documents are printed, they appear to have been produced as a single design when in reality they are multiple completely independent designs. In some cases, the architecture firm is in a different region of the country than the engineering firms and specialty consultants complicate communication during joint development of the design.

The solution to resolving conflicts during the construction process is to implement an extensive coordination process during preconstruction and construction. This process was traditionally completed utilizing hard copies of the prints, light tables and red pens. This process is expensive and inefficient due to the resources required to produce full size prints, markup changes by hand, document changes, produce copies and distribute the information.

This document provides a description of the methodology used and results obtained from modifying our coordination process to utilize AutoCAD and working primarily with soft copies of the contract documents. This project report is divided into four groups. The sections chosen were a Literature Review, Review of Procedure and Methodology, Report of Results, and Suggestions for Future Work

History

Background of coordination utilizing traditional methods

With the movement towards increased use of “fast track” construction, a strong coordination program is essential to the success of the project. In the past, the architects and engineers would have adequate time to complete the design and design review process prior to the start of the construction activities. Today’s construction typically incorporates a design build approach. This approach allows the schedule to be accelerated but also prevents coordinated drawings from being produced by the design firm prior to construction.

An additional problem is the pace of construction is much quicker than the pace that updated drawings can be distributed and incorporated. During fast paced construction, the architect and engineer might only provide a schematic design. The individual contractors develop these schematics into shop drawings. The shop drawings are reviewed and then coordinated with other trades. Often this work is occurring after the building foundation work as begun.

The traditional hard copy coordination system falls apart during coordination because there is not enough time for contractors to incorporate other contractor changes and complete their own design while maintaining the project schedule. Each of the contractors are constantly tweaking their design to meet space and performance requirements. Since the contractors do not have time to incorporate other contractor

changes, these changes are not reflected or considered when developing their drawings. Information is missing or neglected as the final design is developed.

Another problem caused by the traditional system is increased mistakes during the field installation. This leads to problems such as the systems not fitting due to space being encroached on by other trades, performance being reduced by modifications made in the field, and increased costs due to rework. The most costly problem is schedule delays due to redesign time.

On a typical project, the coordination process did not start until after the shop drawing process was completed. Each contractor would develop their shop drawings independently. There would be an independent review of the shop drawings by the design engineer. The design engineer comments would be incorporated and final shop drawings produced.

The coordination process would start by each contractor bringing hard copies of the final shop drawings to a coordination meeting. At this meeting, the drawings would be reviewed and conflicts identified. Many conflicts were not detected due to using two dimension drawings to review a three dimension design. More conflicts are usually discovered in the field during installation.

The challenge has been increased by the requirement to fit more services within the same or less space as buildings become more automated. The traditional methods do not provide the flexibility and speed required to maintain the project's momentum. In the past, the most common method for detecting clashes was the use of light tables.

Each trade would use the prints they provided at the meeting in conjunction with a light table. Where the services crossed, the area would be investigated to see if there was a conflict. For this method to work, all drawings had to be in the same scale and utilize the same match lines.

Light table coordination is still used, but it is not as effective as electronic methods. As more sheets are required to be overlaid, the ability to cast enough light through the stack decreases. Without adequate light, it is not possible to identify the clashes. The common solution is to compare 2 to 3 drawings at a time and then exchange prints until all necessary combinations have been reviewed. Upon identification of the clashes, the drawings must be revised and reproduced and that area reviewed again. Depending on the number of trades involved, this process can become very time consuming and cumbersome.

Another flaw with the light table method is the inability to produce a single coordinated sheet. Each area will require a stack of drawings that represent the final shop drawing for each trade. This creates problems for an owner to maintain a large stock of maintenance drawings each showing a part of the work. It also creates difficulty for contractors if a future change needs to be implemented, the contractor must review multiple drawings to insure the work will fit.

Transition to soft copy coordination

The goal of this project was to implement a coordination process through the use of AutoCAD. The contractors were directed to use the same CAD program and version for completion of their shop drawings. The HVAC contractor and Piping contractor also used these programs to export instructions to their fabrication machines. All contractors had previous experience with a version of AutoCAD prior to beginning the project.

During the bid process, it was clarified that all contractors were required to complete their shop drawings utilizing AutoCAD 2004 to 2006. This was to insure file compatibility between trades. All drawings were to utilize the "scrubbed" backgrounds and x-refs and be printed in ¼" scale. These base files were created by a third party CAD development company. The labeling conventions and layer control requirements were also outlined and defined by the CAD house. (Appendix A)

The program plan required each contractor to post their current drawings on Friday between 7AM and 3PM CST. This would allow the database administrator to search for files by time window to insure they collected the most current files. These files were then compiled into a single drawing that would be reviewed during a Tuesday coordination meeting. During the meeting, clashes would be identified and a solution suggested. The contractor would then implement a rough version of the fix for the Thursday meeting. This meeting would utilize 8x11" sketches showing specific areas for review. The smaller sketches were able to be printed locally on personal printers. This eliminated added costs and time for a printing shop to produce full size plots (30 x 42").

If a proposed solution was found, the drawings were updated from the marked up sketches and posted by the following day. If the problem was not solved, additional sketches would be produced for the following meeting.

Prior to starting this project, no member of them team had experience sharing drawings outside of their own company utilizing AutoCAD. Each contractor had implemented a program within their company only. The companies that performed multiple areas of work were able to seamlessly share drawings between trades in house. The assumption was that this process could be mimicked when working with other contractors.

The initial steps were to establish a naming convention, layers, labeling style, dimension style, and contractor colors. Each contractor was expected to complete their shop drawings utilizing the detailed design documents produced by the Architects and Engineers as a basis for this work, the outlined criteria for production of their drawings was established prior to commencing work. Upon approval of their shop drawings, the consistency in document development allowed the individual shop drawings to be compiled into a composite set to start the coordination process.

Architect / Engineer design phase

To build a successful AutoCAD coordination process, the original design documents must be designed to support the effort. It is typical for an architectural firm to hire an engineering firm to complete the mechanical and electrical portions of the design. The engineering firm will use the same background, but produce the drawings

independent of the architectural drawings. In some cases, the engineering firm also produces mechanical and electrical drawings independently. When the drawings are produced with this method, they cannot be assembled into a single package. One package must be chosen as the base drawings and all other trades redrawn into the proper file format.

The most effective approach would be to have coordination controls implemented during the initial design of the process. The detailed design drawings could then be used as the basis for coordination without the need for rework. Instead of redrawing the package, the drawings would then just require modifications to incorporate improved information to expand the single line drawings to a 2D rendering or develop 3D drawings utilizing the established document package.

If possible, it would be best to have the project designed in the 3D workspace. This would allow for initial coordination to occur during the design process. As the drawings were being produced, the congested areas would be apparent and could possibly be avoided during this phase. This process could be automated using a 3rd party collision software package. Most architectural firms are opposed to this method due to fear of increased liability for errors found during coordination. The errors should have been apparent during the initial document development since the documents were produced and combined in 3D during development.

Bid Process / Job Buyout

It is essential to clearly define the requirements and expectations during the bid process. Producing documents that meet the required criteria requires the draftsmen to have a good understanding of the program packages that have been selected. Many contractors use 3rd party CAD programs or plug-ins that support their manufacturing processes. During the bid process, the requirement to use a specific project must be identified. These additional requirements and software must be accurately identified and analyzed for compatibility during the bid phase. Any special requirements should be included in the job buy out and included in the contract documents.

The required participation and time commitment expectations must also be included in the negotiations. It is imperative the tasks are properly staffed to allow the program to function at the necessary pace. The team for each company requires a project manager to insure the progress is working in a direction that supports the needs of the project. Within the team, it is necessary to have participants that understand the means and methods of field installation and the operation of the system to be installed. This member should also be able to provide suggestions for resolving issues they have previously experienced. They also provide feedback when an idea creates a problem that could not be implemented in the field.

There are two groups that manage and develop the drawings. The first is the database/FTP site manager. Their primary responsibility is storage and assembly of the documents. With the large number of drawings that are constantly being changed and

moved, a robust system is needed to insure the right people have the right information. The draftsmen are the second group and they produce the actual drawings. They must have the ability to convert the detailed design drawings, contract drawings, marked up sketches and notes into the coordinated drawings. They will also have the responsibility of managing the naming of the files and organization of their layers to insure they remain consistent with the criteria established.

The final requirement is personnel to serve as document control. As new drawings are being produced each session, the changes that affect work currently or soon to be installed must be distributed to the installation crew prior to the start of this work. They must also audit the prints in the field to insure the proper prints are being used. This process must be completed by all participants in the project.

Shop Drawing Development

Developing shop drawings is the predecessor to coordinating the work. Design documents typically show the intent of the design. The contractors must complete the design and confirm all calculations. These drawings provide all the critical size and layout information for the system. Once the shop drawings are complete, they must be reviewed by the Engineer of Record (EOR). Any adjustments or changes required by the EOR must be implemented and drawings resubmitted. This process could repeat multiple times depending on the complexity of the system. Once the EOR is satisfied the contractor has demonstrated an adequate knowledge and understanding of the work, the drawings are approved and the coordination process may start.

Mechanical / Electrical Coordination

Once the contractor received confirmation the shop drawings have been approved, they must be prepped for use in the coordination process. All extraneous information must be removed to prevent the composite coordinated drawings from being cluttered to a point of uselessness. Proper layer control allows this process to be completed quickly. The layers are assigned to insure shop drawing information that is not necessary to the coordination process is located on independent levels that can be turned off. In some instances, this addition information is required when a field installation print is produced for the field foreman. If proper layer control does not occur during the initial drawings, a new layer must be created and needed information transferred over. Typically the quickest way to correct this issue was to make a copy of the layer and delete the extra information from the layer that would be used during coordination.

Additional information is required to be added to the title boxes once the coordination process starts. These boxes must identify the area and systems included. It must also provide a means for identifying the revision of the drawing. The final addition is a signature block for each contractor to sign to confirm they can install their work in harmony with the other trades. This is critical for insuring the drawing accurately identifies their routes.

Document Control

Implementing an AutoCAD coordination process requires a significant document control effort. It is essential for all contractors to use the correct set of drawings throughout the process. As each contractor completes updates, the project files must also be posted for other contractor's use. The completed drawings must then be distributed to the field personnel for guidance in the installation of the work.

The initial step in document control is establishing a system for storing and distributing the files. This project utilized a web based system managed by a third party. Based on the expectations of the project documentation, an extranet site was developed (Appendix D). This site provided areas for each step of the coordination process as well as posted submittals. Within these areas, a tracking system was implemented to notify users the status of each drawing. Design of this system provided an expected project flow to insure the proper sequencing of the drawing production (Appendix B). As a task was completed, a notification is sent to the next contractor to begin their work. This process repeats until all contractors have fulfilled their requirements.

With daily updates being posted to the working folders, the older versions must be archived so that only the current file is listed. The archival process utilized 3 levels. The initial archival placed the recent drawings within a folder in the work area. This allowed a quick comparison of recent changes. If the proposed solution created new problems, an evaluation could be made to establish if the process should continue or

revert to the previous drawing and attempt a new solution. Typically, two weeks of revisions were kept within this folder.

The second level of archival moved the older files out of the work area into an archival section of the Extranet. These files are compressed and all plot versions (Adobe PDF and AutoCAD DWF drawings) are removed to save storage space. These files are accessible to review the process history, but are not used in the current coordination process. The files could still be plotted from the drawing file (AutoCAD DWG) but it requires the full document collection to be present within the same file. The plot files suitcase all necessary information into a single file for simplicity in movement and distribution of the file for people that do not requiring editing ability.

The final step of archival removes the files from the extranet system. Three copies of the files are burned onto 100 year compact discs. Following the recording process, these CDs are tested and then distributed to 3 locations to minimize the risk of catastrophic loss. One copy is maintained at the jobsite and the other copies are distributed to the Extranet Company and the owner's rep. The contents of each CD are cataloged for future reference.

The extranet server utilizes 2 servers located in different geographic regions. Each server is capable of completely operating the extranet independently. The servers were designed to sync the data to insure both servers contained the same information. Additional protection was implemented by utilizing an automated daily backup each evening. Each back up drive stores independent images of the last 7 days on separate

drives. The data is replaced utilizing a first in, first out system. An addition monthly backup is also part of the automated system. This system captures 2 days of images each month. The capacity of the backup storage space is sized to have the ability to store 24 months of full project design images. The monthly recording process also utilizes a first in, first out overwrite protocol.

The daily operation required an accurate way of identifying the current files and updates. This feature was incorporated into the Extranet. Once implemented, the process was then automated to eliminate the probability of operator error from manually completing this task. As new files are posted, they are manually consolidated into a composite drawing. This process requires 2 days to complete and plot. To insure the proper files were compiled, each contractor was required to post the files they want compiled on Fridays between 7AM and 3PM CST. The Extranet Contractor sorted the information by this time window to select the files for assembly. If a new file was not posted during the posting window, the old file was left in place.

Another issue that must be managed is the labeling of the files. Since AutoCAD imports X-Refs by name references and location within the same folder, proper naming is essential. As part of the assembly process, each file is renamed to match the expected name. The files are then copied into the assembly folder. Within this folder, 3 versions of the drawings are produced. The DWG is an AutoCAD drawing format. It allows for the file to be edited. It also allows selection and hiding of levels. All files in the assembly folder are required to view or plot the complete drawing. The second

format is a DWF file. This is an AutoCAD plot file. All needed information is suitcased within a single file. Utilizing a plot file retains the ability to manipulate the layers and plot the file only. These files cannot be edited in this format. Viewing the DWG or DWF files require AutoCAD software or an Autodesk DWG or DWF viewer. The software must be purchased and licensed but the viewers are available for free download on the AutoCAD website. The final version is a PDF. The PDF format is typically used to distribute the information to people outside the coordination group. This format allows for viewing of the files using Adobe Reader or Adobe Acrobat. The file only provides the view of the layer format at the time of conversion. If multiple views are required, a PDF must be produced for each view. To limit wasted effort, the PDF file is produced as the final step of each area of coordination.

File size will also become a problem if the layers are not properly managed. As each contractor is using the x-refs to produce their layers, there is a potential for there to be repeated layers when the files are combined. In most cases, unnecessary layers are turned off to remove them from view, but they still occupy space within the file. The solution was to direct each contractor to extract and submit only the specific layers assigned to their trade. The X-refs would already be present in the assembly folder. Without this process, each contractor increased the file size by 84 layers of repeated data. The files for each floor grew, in one case the repetitive data caused the file to grow to approximately 2.5 gigabytes instead of the typical 50 – 150 megabytes.

As new files are completed, the final product must be plotted and distributed. These copies must update the office drawings as well as the field drawings. The update process must track all files currently being used on the job and remove outdated files from use. Due to printing costs, the contractors are hesitant to constantly update drawings for minor revisions. The contractors preferred solution would be to redline the existing drawings. For the drawing update and removal process to be successful, the Construction Manager must perform regular audits to force compliance. Any costs created from use of outdated drawings must be tracked, quantified and passed on to the offending contractor. An alternate lower cost option to replacing full size plots for minor changes would be to issue 8 ½" x 11" sketches produced from the updated drawing file. These sketches would then be issued and inventoried during the drawing audit.

The final step is to produce detailed field sketches for use for specific areas of complex installation with interactions between trades. These sketches provide sections of critical areas on 8" x 11" or 11" x 14" pages. These forms are significantly more manageable in the field than a full size 30" x 42" plot. Some contractors also opt to use half size prints. Currently, the capability to produce these plots in house does not exist. Therefore, this requires the full size prints to be sent to a copy house that will scan and print ½ sizes for an additional fee.

Field Coordination

Field coordination occurs when the coordinated drawings do not work with the field installations. These problems can be caused by numerous reasons. The most common is installation error. Another cause is the cumulative effect of allowed tolerances. The third common cause is not identifying a problem on paper prior to the installation. In all cases, a resolution must be found, documented, and implemented.

When a problem is found in the field after a partial installation of the systems, there are costs associated with any rework. The goal is to find a solution while minimizing the financial impact. The last resort is to remove and reinstall a complete assembly. The process to resolve field issues is to identify the conflict. Compare the current installation with the coordinated drawing, propose solutions, identify if the solution is acceptable, implement the solution, and document the change.

Documentation requires several steps to insure it occurs accurately. The condition in the field must be converted to a detailed sketch identifying all the critical components and elevations. This information is then distributed to the proper AutoCAD draftsmen for implementation into the current drawings. These drawings must then be reviewed for accuracy and the Extranet updated. If the work is still occurring in that area, the revised drawings must be plotted for distribution. This initiates the replace and removal of old drawings activity to insure the information is distributed to all critical parties.

As-build documentation

As installation is being completed, each contractor is responsible for redlining a set of drawings to later be used for development of the as-built documents. The intent of the as-built drawings is to provide a final set of drawings showing how the building was actually constructed. To facilitate this process, the red line drawings are to be updated on a daily basis. If the variations in the field create a coordination issue, these drawings become the basis for the field coordination sketches. During the process, automation utilizing tablet PCs with the ability to mark up PDFs of the area which were preloaded on the system was tested. This is an option that should be implemented in the future, but we lacked the resources to incorporate it as a part of our scope.

The format for the as-builds is identical to the shop drawings. Contractors who did a better job coordinating their work with other trades reduced the work required to produce these documents. On some projects, this will be the responsibility of the Architect and Engineering Firms. In all cases, the contractors will be required to submit a red line set of drawings for the Architect to use in producing the final documents.

Results

The team was able to implement an AutoCAD coordination process as intended. During this implementation, some expectations were exceeded while others achieved unexpected benefits. There were areas that fell short in meeting the project goals and should be revised. Overall, the project has been viewed as a success by the client and project lead.

The initial benefit of the AutoCAD system was found by combining the detailed design documents that were produced independently by multiple consultants into a single document. An initial interference program was run to identify the clashes. This list of issues was prioritized based on the project schedule to develop a sequence for completing the process. This allowed us to optimize our coordination efforts.

The primary requirement was to be able to complete coordination for an area in advance to the construction activity start date. Utilizing a system that allowed the ability to immediately review the results and see other impacts significantly accelerated the process. As a change was implemented, the improvements and impacts were seen in real time on the monitor by all contractors. Each contractor was able to see all the systems at one time and provide resolution suggestions. This allowed us to quickly review the multiple options for second and third generation impacts prior to committing

to a concept. Time and cost savings were realized by eliminating the requirement to produce conceptual drawings prior to starting the review process.

Time and money was also saved by eliminating the requirement of plotting progress drawings in-between steps. Due to the large amount of systems and equipment in each area, we needed to produce multiple drawings with various layer configurations to clearly see all work within a space. The AutoCAD system allowed us to turn layers on and off during the coordination session to quickly isolate problems. Once a specific area was isolated, a small sketch could be printed locally. This was a vast improvement from uploading the drawings to the printing company and waiting until the following day for delivery. A secondary benefit was a reduction in plotting costs.

An unexpected benefit discovered early in the project was the ability to review the floor sleeves in comparison to the structural drawings in addition to the architectural drawings. When designing the floor sleeve layout, the system is typically based on the architectural drawings. The goal is to insure the system is either entirely within a wall cavity or completely clear of the wall face. During field installation, these sleeves shift slightly if they conflict with a structural member. This condition is created because a comparison to the structural drawings is extremely difficult to complete. This sleeve shift will often require re-work in the field when the wall layout is complete. Utilizing the CAD system allows us to complete the layout based on the architectural backgrounds and then change the background layer to the structural. Conflicts with the structure could be quickly identified and a new location selected and rechecked.

Utilizing this method eliminated the need to perform any sleeve rework other than a few errors made during field installation.

Another unexpected benefit was the ability to save project costs and reduce congestion by developing a combined support system for multiple services. In areas of service pathways, all systems were drawn and coordinated. This information was then used to calculate weights and spacing. A large trapeze rack system was then designed to eliminated individual hangers or strut for each system. The space gained was then manipulated to increase maintenance and access spaces at critical areas.

The final significant benefit was always having an accurate drawing for reviewing and installing the work. Each contractor had the ability to produce a drawing with the most current information for their field personnel. When work was completed in the field, as-built information documented and incorporated into the coordination drawings. This allowed for implementing owner changes easily as well as eliminating the need for a separate activity to produce as-built drawings for the client's future use.

Some of the areas that did not work as well as planned were consistency in the use of the extranet site. All contractors utilized the site for the minimum coordination effort, but some did not incorporate the submittal information sections or start-up sections. Utilizing these sections would have made this information available to all other contractors. The submittal section provided an area to upload Adobe PDF scans of the approved submittals. When working in close proximity of other trades, availability of the product data would have simplified the process of coordination

connections and avoidance of access spaces required by the equipment. The start-up section provided status and schedule information for the being installed. This system automated the process of sequencing the factory startup and testing of the equipment. For the trades that did not participate in the section, this schedule was completed manually.

We also had difficulties in compiling some drawings when third party plug-ins were used in conjunction with AutoCAD. Not all plug-ins were backwards compatible with systems lacking the plug-in. In these instances, some contractors were not able to view all areas of the files. These drawings would need to be reverted to a compatible version and re-posted prior to use. There was no system in place to identify where this could occur. The problems were usually identified through trial and error. Many of the contractors did not have an understanding of what plug-in was installed on their CAD stations and in some cases; there were multiple versions of plug in packages within the same office creating an intermittent problem.

Each trade was given a color to aid in the identification of each contractor's lines. When working in AutoCAD, the drawings appear on a black desktop. The colors were very effective at this time. When a plot was produced on white paper, not all the colors were easily visible. In some instances, information was missed because the other contractor was not aware the information was not visible once plotted.

A specific layer management plan was developed based on the expectation of the future requirements. As the program progressed, additional layers were required by

some trades. The established system did not provide guidance on how to incorporate and document the addition of new layers. Each contractor incorporated a different solution to this problem. This inconsistency required rework on some drawings to resolve the layering issues. Prior to this rework, layers with critical information did not always get illuminated prior to the coordination review.

Managing the complied drawings was complicated due to the size of the file. As the drawings progressed these files grew significantly. This was partially cause by mismanagement of layers. Each contractor was given a base set of X-Refs to provide background, column lines, name blocks, etc. During the production of shop drawings, must contractors imported these files into their drawings to increase portability of the file during in-house development. These drawings did not get removed prior to posting to the FTP site. This created duplicate layers for each revision that was posted. The cumulative effect eventually increased the file size to a point where most computers could not efficiently handle the file. The resolution of the problem required a detailer to manually find and remove duplicate layers prior to continuing with the consolidation process.

Suggestions for Additional Work

The scope of this report was limited to a single construction project. The latitude to the research and evaluation is too specific to be implemented globally within the organization. This research does provide a foundation for developing a broader system that could be utilized for development of a companywide program. The areas of additional research that would provide the most benefit would be improving the design phase in preparation for an AutoCAD coordination process and improved the document control. One benefit we are currently exploring is using the Extranet for managing the commissioning process (Appendix E). Similar to the other tasks, this system provides a location for storage of documents, tracks progress, and notifies participants when action is required.

The architectural industry is moving toward 3D design platform. This new method of design is called Building Information Modeling (BIM). This format allows for the design to be completed in a 3D space. In additional, all pieces of the design carry the product data or specifications within the associated database. All major software design companies have implemented a version of BIM. Utilizing this system for the base design, would incorporate many of the initial steps of coordination during the design stage of the project.

The problem with the BIM software in its current revision is the lacking support for the mechanical, plumbing, electrical, controls, and specialty systems. This work would still require an extensive coordination effort. In addition, any global solution for supporting these trades would need to provide compatibility with existing manufacturing systems currently used by the contractors. The information would also need to allow output into a simpler format that could be prepared to support field installation.

As drawings become more detailed, the file size will continue to increase. Finding a way to more efficiently manage these files is essential to continuing to develop a softcopy coordination process. As we found during our coordination process, there is a file size at which a computer is not longer capable of manipulating the file. This point varies with the hardware and software configuration of that particular computer, and therefore is not a fixed point. A beneficial approach would be to utilize good file management for minimizing the file sizes prior to reaching the breaking point. The scope of this project only included minimal research in this area.

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Appendix

Appendix A – Naming Convention for Layer Management

DISCIPLINE		LEVEL		AREA	QUADRANT	SUFFIX	
H	HVAC SHEET METAL	0	BASEMENT	1	1	U	UNDERGROUND
HP	HVAC PIPING	1	1ST FLOOR	2	2	A	INTERSTITIAL
P	PLUMBING	2	2ND FLOOR	3	3	R	ROOF
FS	FLOOR SLEEVE	3	3RD FLOOR	4	4		
E	ELECTRICAL	4	PENTHOUSE	5			
FP	FIRE PROTECTION	5	ROOF				

File Naming examples

P Level 1 Area 3	Translation - Plumbing, Ground Level, North Lab
E Level 0A Area 4	Translation - Basement, Interstitial Area, South Lab
P Level 1 Area 3-1	Translation - Plumbing, Ground Level, North Lab, Area 3, Quadrant 1
E Level 0A Area 4-4	Translation - Basement, Interstitial Area, South Lab, Area 4, Quadrant 4

Acceptable Modifiers

During Coordination specific interference issues can be accomplished by adding an abbreviated description at the end of the file name.
These are working files
only to solve issues

P Level 1 Area 3-1 - PCW-Duct crash	Translation - Plumbing, Ground Level, North Lab, Area 3, Quadrant 1, problem with water line hitting duct

Appendix B – Sample Drawing Schedule

Coordination Drawing Sequence Concrete Pours Only

Level		North	South	West	East	Shops	Approval	Materials	Pour Date	Status
SOG	Pit #2 Frame	X						4/5/06		
SOG	Pit #3 Frame		X	X						
SOG	Pit #4 Frame		X		X					
Ground 1	Mech Sleeves	A	H.5	4	7.5	4/3/06	4/13/06	4/10/06	5/5/06	
Ground 1	Elec Sleeves	A	H.5	4	7.5	4/4/06	4/13/06	4/10/06	5/5/06	
Ground 1	Embeds	A	H.5	4	7.5	4/6/06	4/13/06	4/10/06	5/5/06	
Ground 2	Mech/Elec Sleeves	A	H.5	7.5	11.5	4/7/06	5/3/06	4/27/06	5/24/06	
Ground 2	Embeds	A	H.5	7.5	11.5	4/7/06	5/3/06	4/27/06	5/24/06	
Ground 3	Mech/Elec Sleeves	A	H.5	11.5	14.5	4/7/06	5/23/06	5/16/06	6/13/06	
Ground 4	Mech/Elec Sleeves	H.5	R.9	4	7.5	4/7/06	6/8/06	6/5/06	6/29/06	
Ground 5	Mech/Elec Sleeves	A	H.5	14.5	18	4/7/06	6/9/06	6/2/06	6/30/06	
Ground 6	Mech/Elec Sleeves	H.5	R.9	7.5	9.5	4/7/06	6/28/06	6/21/06	7/19/06	
Ground 7	Mech/Elec Sleeves	H.5	R.9	9.5	12.5	4/7/06	7/17/06	7/11/06	8/7/06	
Ground 8	Mech/Elec Sleeves	H.5	R.9	12.5	15.5	4/7/06	8/3/06	7/28/06	8/24/06	
Ground 9	Mech/Elec Sleeves	H.5	R.9	15.5	18.5	4/7/06	8/23/06	8/16/06	9/13/06	
2ND	Sleeve Drawings	Complete Floor				4/14/06	6/19/06	6/22/06	7/10/06	
3RD	Sleeve Drawings	Complete Floor				4/21/06	7/18/06	7/24/06	8/8/06	
PENT	Sleeve Drawings	Complete Floor				4/28/06	8/29/06	8/22/06	9/19/06	
Ground 3	Embeds	A	H.5	11.5	14.5	5/2/06	5/23/06	5/16/06	6/13/06	
Ground 4	Embeds	H.5	R.9	4	7.5	5/18/06	6/8/06	6/5/06	6/29/06	
Ground 5	Embeds	A	H.5	14.5	18	5/19/06	6/9/06	6/2/06	6/30/06	
2ND 1		A	H.5	4	9.5	5/29/06	6/19/06	6/22/06	7/10/06	
Ground 6	Embeds	H.5	R.9	7.5	9.5	6/7/06	6/28/06	6/21/06	7/19/06	
2ND 2		A	H.5	9.5	13.5	6/7/06	6/28/06	7/3/06	7/19/06	
2ND 3		A	H.5	13.5	18	6/16/06	7/7/06	7/13/06	7/28/06	
Ground 7	Embeds	H.5	R.9	9.5	12.5	6/26/06	7/17/06	7/11/06	8/7/06	
3RD 1		A	H.5	4	9.5	6/27/06	7/18/06	7/24/06	8/8/06	
3RD 2		A	H.5	9.5	13.5	7/6/06	7/27/06	8/2/06	8/17/06	
Ground 8	Embeds	H.5	R.9	12.5	15.5	7/13/06	8/3/06	7/28/06	8/24/06	
3RD 3		A	H.5	13.5	18	7/17/06	8/7/06	8/11/06	8/28/06	
Ground 9	Embeds	H.5	R.9	15.5	18.5	8/2/06	8/23/06	8/16/06	9/13/06	
PENT 1		A	H.5	4	9.5	8/8/06	8/29/06	8/22/06	9/19/06	
2ND 4		H.5	R.9	4	9.5	8/9/06	8/30/06	9/5/06	9/20/06	
2ND 5		H.5	R.9	9.5	13.5	8/18/06	9/8/06	9/14/06	9/29/06	
PENT 2		A	H.5	9.5	13.5	8/24/06	9/14/06	9/11/06	10/5/06	
2ND 6		H.5	R.9	13.5	18	8/29/06	9/19/06	9/25/06	10/10/06	

Interstitials not included

Coordination Drawing Sequence Concrete Pours Only

Level	North	South	West	East	Shops	Approval	Materials	Pour Date	Status
3RD 4	H.5	R.9	4	9.5	9/7/06	9/28/06	10/4/06	10/19/06	
PENT 3	A	H.5	13.5	18	9/11/06	10/2/06	9/27/06	10/23/06	
3RD 5	H.5	R.9	9.5	13.5	9/18/06	10/9/06	10/13/06	10/30/06	
3RD6	H.5	R.9	13.5	18	9/27/06	10/18/06	10/24/06	11/8/06	
PENT 4	H.5	R.9	4	9.5	10/19/06	11/9/06	11/2/06	11/30/06	
PENT 5	H.5	R.9	9.5	13.5	11/6/06	11/27/06	11/21/06	12/18/06	
PENT 6	H.5	R.9	13.5	18	11/16/06	12/7/06	11/21/06	12/28/06	

Interstitials not included

Appendix C – Sample Meeting Minutes

Meeting Minutes

Detailed, Grouped by Topic for each Meeting and by 'Old Business' and 'New Business'

Consolidated Lab Facilities **Project # 10820** **The Whiting-Turner Contracting Company**
2000 Dayton Ave. Tel: 515-233-1030 Fax: 515-233-2973
Ames, IA 50010

10820 - Coordination Meeting Meeting 4

Date	Start	End	Next Meeting	Next Time	Prepared By	Company
3/29/2006	01:00 PM	01:58 PM	4/5/2006	01:00 PM	Chris Neal	The Whiting-Turner Contracting Company

Purpose	Location	Next Location	General Notes
Coordination of USDA Consolidated Laboratory Facility	WT Field Trailers, Ames Iowa	WT Field Trailers, Ames Iowa	

Attended By	Non-Attendees
The Whiting-Turner Contracting Company - Chris Neal	The Whiting-Turner Contracting Company - Michael Briselden
The Whiting-Turner Contracting Company - Katrina Gilliam	The Waldinger Corporation - Jim Snodgrass
The Whiting-Turner Contracting Company - Mike Meyhoefer	Baker Electric Inc. - Gary Edgington
The Waldinger Corporation - Nate Slauson	VGI Design - John Trickel
The Waldinger Corporation - Steve Brommel	
Baker Electric Inc. - Chad Layland	
Baker Electric Inc. - Dave Keicher	
Baker Electric Inc. - Scott Farnsworth	

Item	Meeting Item Description	Resp	Status	Due Date	Compl'd	Cls'd
General Business						
Old Business						
Extranet						
001-002	The document control system will be an extranet developed and managed by VGI Design. Individual and group training will be held for use of the system 3-15 No progress. 3-22 Waldinger is finalizing the flow process. A draft flow chart was distributed for review. The drawings are currently being posted to the site. 3-29 The flow chart is set, the dwgs are still getting posted to the site.	All	Open	**3/31/2006** (Original: 3/8/2006)		No
Coordination						
001-014	Pan drawings will not be available for the early slab pours. The contract structural drawings shall be used for early coordination. Later coordination shall use the pan drawings 3/22 The shop drawings for the slabs was received on 3/21. WT has found not differences in the areas of the 1st two pours. These drawings did not include the pans. 3/29 Waldinger inbeds for the pits will be discussed in a	Waldinger, Baker Electric	Open	**3/31/2006** (Original: 3/31/2006)		No

Item	Meeting Item Description	Resp	Status	Due Date	Compl'd	Cls'd
	seperate meeting.					
Coordination						
003-001	Waldinger needs clarification on how the shafts will be built and how the support steel for pipes and duct will be installed. These questions will be carried forward to the 2PM subcontractor meeting. 3/29 This issues were resolved in subcontractor meeting	Waldinger, WT	Closed	**3/22/2006** (Original: 3/22/2006)	3/29/2006	Yes
Meeting Schedule						
003-002	The first working meeing will be Monday 3/27 at Waldinger's shop in Des Moines. The zones for the shafts will be discussed. Following the shafts shall be the inbed layout. 3/29 The working meeting was held and very productive. The basement problem areas were reviewed. Zones were set.	Waldinger, Baker E	Closed	**3/27/2006** (Original: 3/27/2006)	3/27/2006	Yes
Meeting Schedule						
003-003	10 minutes of future coordination meetings will be allocated to discuss commissioning. Eventually commissioning shall split into it's own series of meetings.	All	Record	**3/22/2006** (Original: 3/22/2006)	3/29/2006	Yes
Coordination						
003-004	In the lab areas, the AL drawings shall be the basis for coordination. These drawings are the ones the USDA will reveiw for layout. Items shown on E, H, or P drawings not on the AL drawings will be identified.	All	Record	**3/22/2006** (Original: 3/22/2006)		No
Coordination						
003-005	Panel information from Square D is expected 3/31. Once received panel size information shall be forwarded to all contractors. All contractors are to avoid passing directly overtop or below the panels. 3/29 Panel information was received from Sq D. This information will be forwarded to Waldinger. The clearance above panels shall be reviewed. Prior to asking for a variance, all other options shall be exhausted.	Baker E	Open	**4/5/2006** (Original: 4/5/2006)		No
Coordination						
003-006	The top of the shaft coordination shall dictate how service enter the bottom of the shaft. This is the priority ofr coordination this week. It will be reviewed at a seperate meeting. 3/29 - Top of shafts have not been reviewed. Waldinger verified Baker Elec space requirements fit the space.	Baker E, Waldinger	Open	**3/27/2006** (Original: 3/27/2006)		No
Coordination						
003-007	Drives shall be located as close to the equipment they serve as possible.	All	Record	**3/22/2006** (Original: 3/22/2006)	3/29/2006	No
Coordination						
003-008	All block outs will be shown on a drawing with dimensions. This information must be given to the structural contractor prior to installation.	All	Record	**3/22/2006** (Original: 3/22/2006)		No

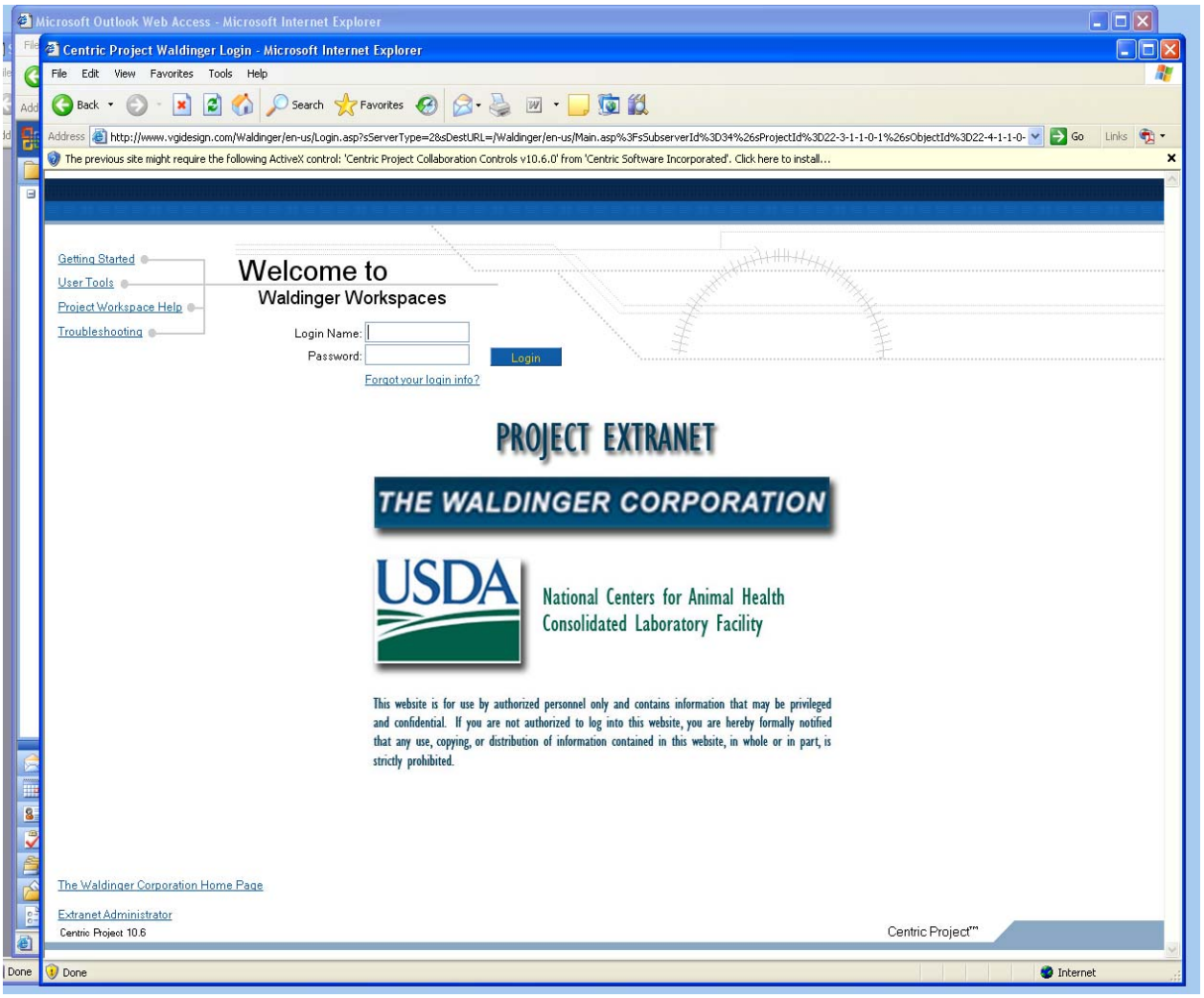
Item	Meeting Item Description	Resp	Status	Due Date	Compl'd	Cls'd
	3/26 sleeve penetrations must also be shown. Drawings for first pour due 4/3.					
New Business						
Coordination						
004-001	Combinations racks are most likely the only option for the penthouse. Coordination in this area will be based on this assumption.	All	Record	**3/29/2006** (Original: 3/29/2006)		No
Coordination						
004-002	Waldinger has identified areas where ductwork risers are over top of doors. This shall be reviewed and a seperate meeting with WT.	Waldinger; WT	Open	**4/5/2006** (Original: 4/5/2006)		No
Coordination						
004-003	Questions about the pans and pan drawings shall be discussed at the 2PM subprogress meeting. The open items are: Can the pans be drilled or cut? How are inbeds installed? Are there other installation details that must be followed?	WT	Open	**3/29/2006** (Original: 3/29/2006)		No
Coordination						
004-004	WT has requested a list of coordination drawings packages that shall be submitted. This list should be the groups of drawings, not idividual sheets.	Waldinger, Baker	Open	**4/5/2006** (Original: 4/5/2006)		No
Coordination						
004-005	Waldinger can not support Bakere Conc.'s request to relocate the recessed walls in the sheer walls. The move would conflict with the carriers.	Waldinger	Closed	**3/29/2006** (Original: 3/29/2006)		Yes
Temporary Power						
004-006	Baker E will meet with Baker C to coordinate the power for the cranes. Open topics are disconnects, lights, recepticles. Baker E also needs more information from Maxim Cranes to verify calcs.	Baker E, Baker C	Open	**4/5/2006** (Original: 4/5/2006)		No

Cc:	Company Name	Contact Name	Copies	Notes

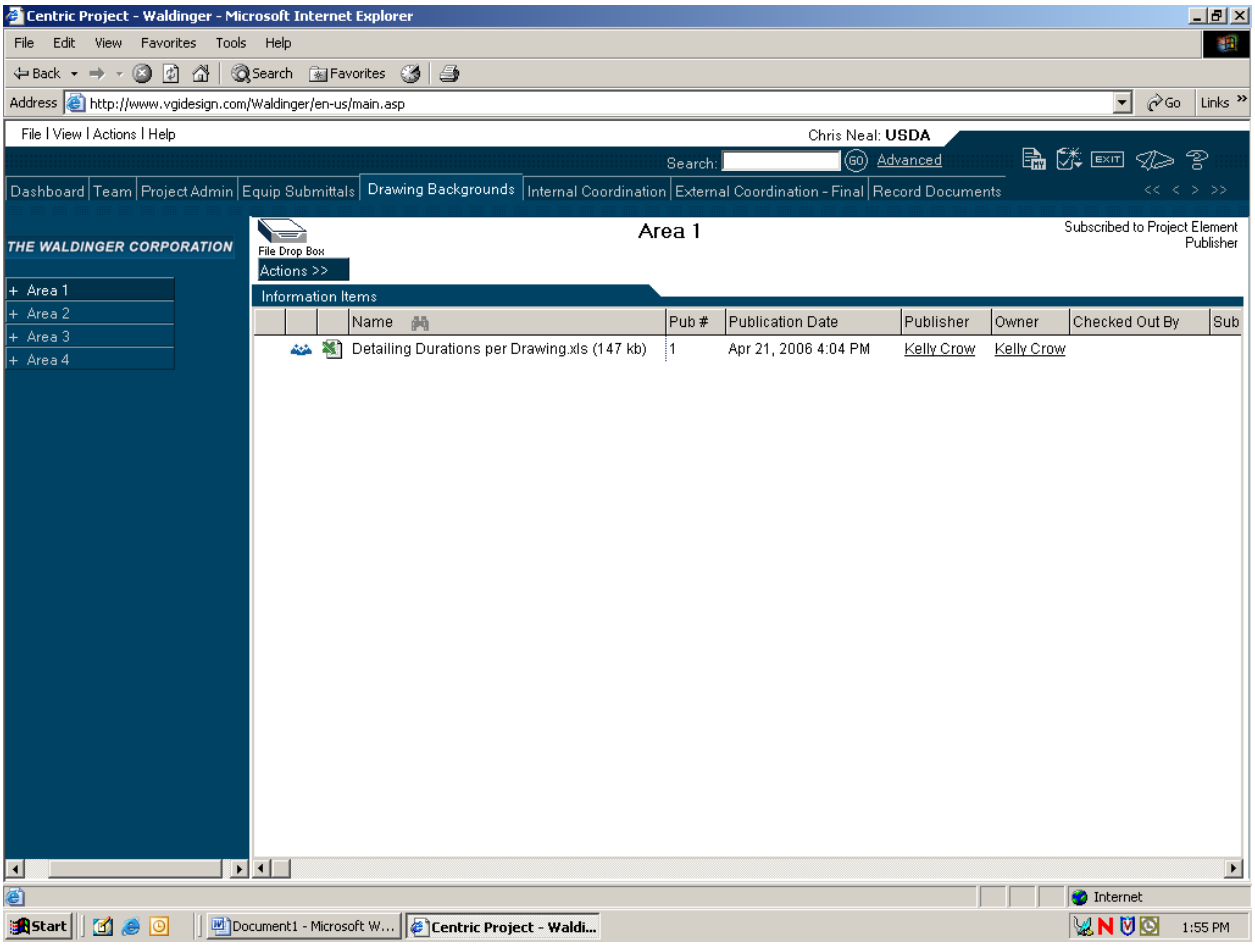
This represents the notes as documented during the meeting by WT. Any modifications, additions, or corrections should be forwarded to the author immediately. These meeting minutes will become part of the Project Files.

Appendix D – Extranet Site Screen Shots

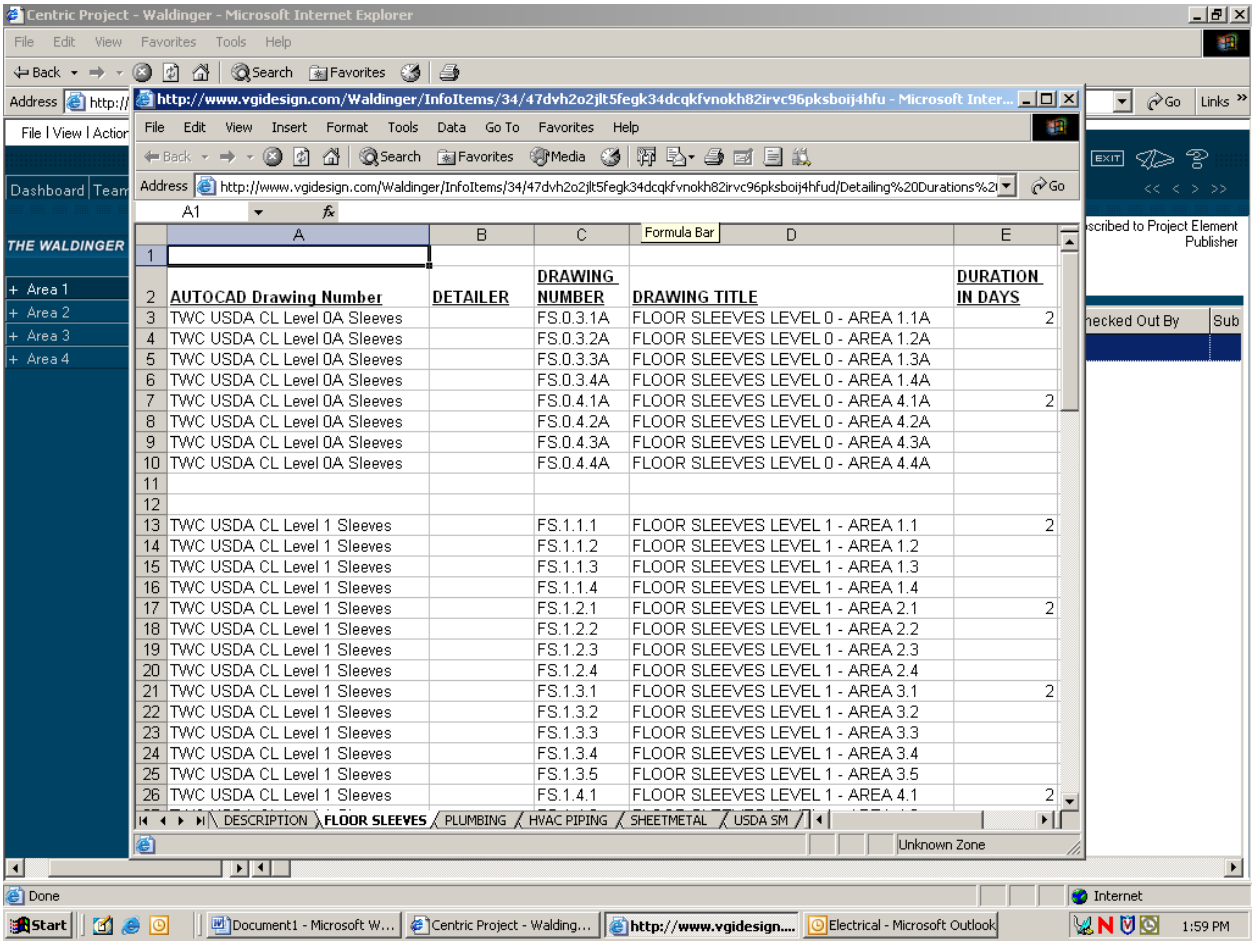
Extranet Base Webpage



Extranet Desktop



Extranet File List - Sample



	A	B	C	D	E
1					
2	**AUTOCAD Drawing Number**	**DETAILER**	**DRAWING NUMBER**	**DRAWING TITLE**	**DURATION IN DAYS**
3	TWC USDA CL Level 0A Sleeves		FS.0.3.1A	FLOOR SLEEVES LEVEL 0 - AREA 1.1A	2
4	TWC USDA CL Level 0A Sleeves		FS.0.3.2A	FLOOR SLEEVES LEVEL 0 - AREA 1.2A	
5	TWC USDA CL Level 0A Sleeves		FS.0.3.3A	FLOOR SLEEVES LEVEL 0 - AREA 1.3A	
6	TWC USDA CL Level 0A Sleeves		FS.0.3.4A	FLOOR SLEEVES LEVEL 0 - AREA 1.4A	
7	TWC USDA CL Level 0A Sleeves		FS.0.4.1A	FLOOR SLEEVES LEVEL 0 - AREA 4.1A	2
8	TWC USDA CL Level 0A Sleeves		FS.0.4.2A	FLOOR SLEEVES LEVEL 0 - AREA 4.2A	
9	TWC USDA CL Level 0A Sleeves		FS.0.4.3A	FLOOR SLEEVES LEVEL 0 - AREA 4.3A	
10	TWC USDA CL Level 0A Sleeves		FS.0.4.4A	FLOOR SLEEVES LEVEL 0 - AREA 4.4A	
11					
12					
13	TWC USDA CL Level 1 Sleeves		FS.1.1.1	FLOOR SLEEVES LEVEL 1 - AREA 1.1	2
14	TWC USDA CL Level 1 Sleeves		FS.1.1.2	FLOOR SLEEVES LEVEL 1 - AREA 1.2	
15	TWC USDA CL Level 1 Sleeves		FS.1.1.3	FLOOR SLEEVES LEVEL 1 - AREA 1.3	
16	TWC USDA CL Level 1 Sleeves		FS.1.1.4	FLOOR SLEEVES LEVEL 1 - AREA 1.4	
17	TWC USDA CL Level 1 Sleeves		FS.1.2.1	FLOOR SLEEVES LEVEL 1 - AREA 2.1	2
18	TWC USDA CL Level 1 Sleeves		FS.1.2.2	FLOOR SLEEVES LEVEL 1 - AREA 2.2	
19	TWC USDA CL Level 1 Sleeves		FS.1.2.3	FLOOR SLEEVES LEVEL 1 - AREA 2.3	
20	TWC USDA CL Level 1 Sleeves		FS.1.2.4	FLOOR SLEEVES LEVEL 1 - AREA 2.4	
21	TWC USDA CL Level 1 Sleeves		FS.1.3.1	FLOOR SLEEVES LEVEL 1 - AREA 3.1	2
22	TWC USDA CL Level 1 Sleeves		FS.1.3.2	FLOOR SLEEVES LEVEL 1 - AREA 3.2	
23	TWC USDA CL Level 1 Sleeves		FS.1.3.3	FLOOR SLEEVES LEVEL 1 - AREA 3.3	
24	TWC USDA CL Level 1 Sleeves		FS.1.3.4	FLOOR SLEEVES LEVEL 1 - AREA 3.4	
25	TWC USDA CL Level 1 Sleeves		FS.1.3.5	FLOOR SLEEVES LEVEL 1 - AREA 3.5	
26	TWC USDA CL Level 1 Sleeves		FS.1.4.1	FLOOR SLEEVES LEVEL 1 - AREA 4.1	2

Appendix E – Commissioning Plan Extranet Training / Instructions

USDA Extranet Commissioning Process

July 12, 2007
Revised August 7, 2007
By VGI Design, John P. Trickel, PE

Summary:

The following are the main bullet points to navigate the complex communication and tracking process of the Commissioning Process on the Extranet.

Participants in the Commissioning are

- Whiting Turner
- Waldinger
- Cornerstone Commissioning
- Baker Electric
- Siemens

The main objectives of this process are to

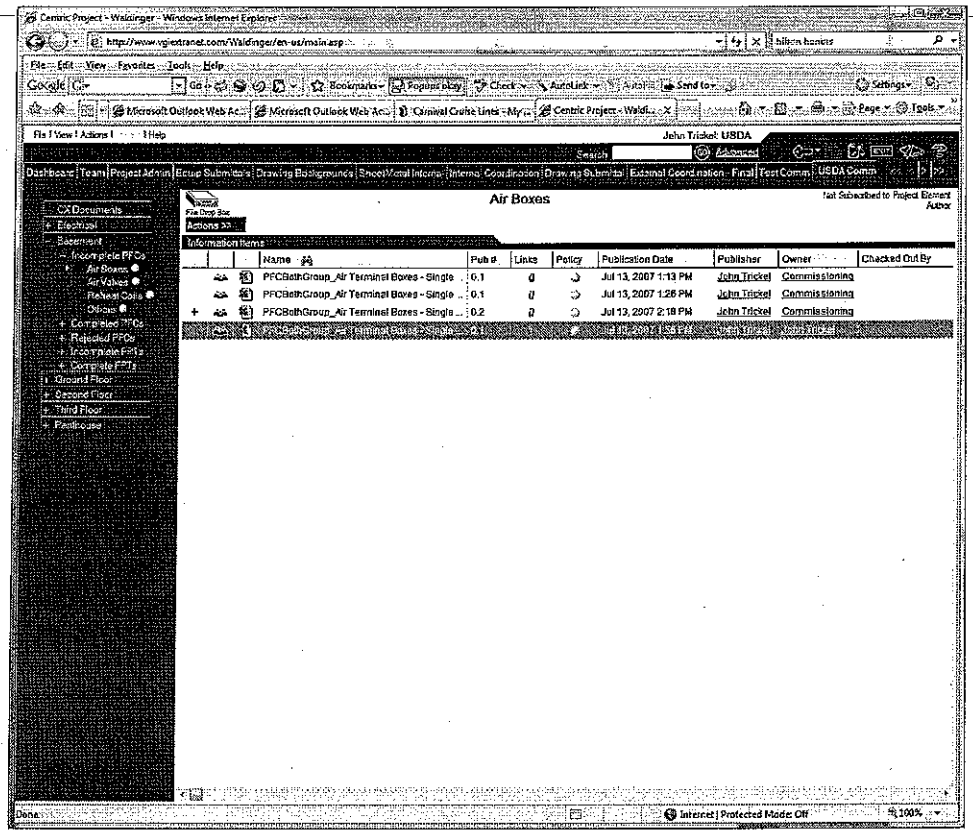
- Provide a true digital, paperless and collaborative process that facilitates the Commissioning process across multiple trades in diverse locations and in real time.
- File publication history, date stamping and information Ownership to drive accountability and push the entire commissioning process forward unencumbered by the communication component of the process.
- Provide Check In/Out sequencing and visibility for "one-at-a-time" information editing between trades so information is never duplicated. One file or Information Item is visible simultaneously to all team members.
- Provide Approval Tracked Activity Log for multi-trade digital sign off of key milestone events per Excel file. The Log will be set up on a "per floor" basis and will provide visibility to all team members to sign-off status. The Log will also provide essential sorting and accountability measures to quickly obtain vital information regarding a particular piece of equipment, system type or contract document sheet name.
- Status and Reporting that is automatically organized and collated

Main components of the Commissioning Extranet process

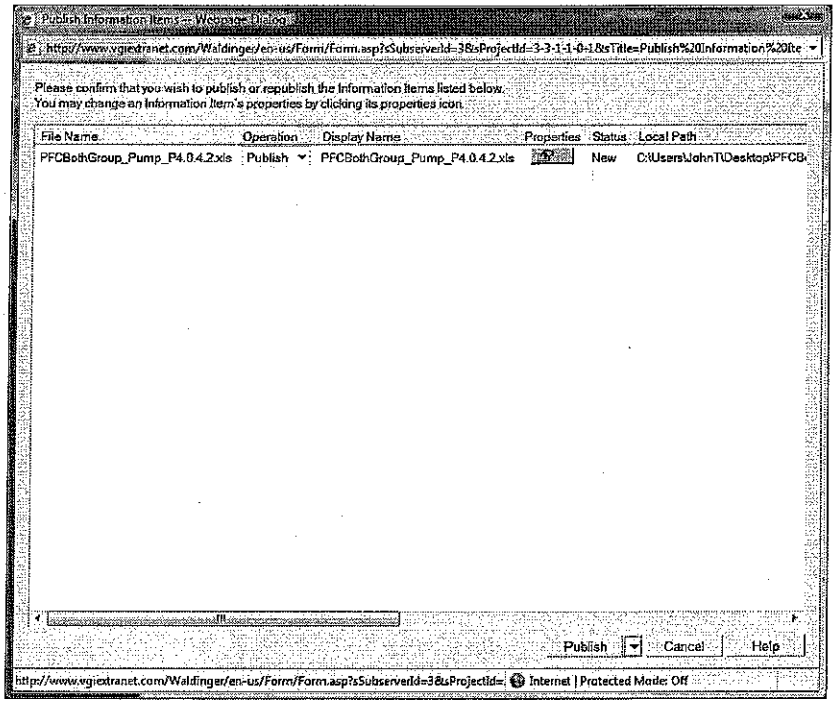
- Initial file Excel file publishing and Approval Tracked Activity Log data entry
- Check In/Out Excel file editing by various trades
- Trade Approval digital "sign off" of individual Excel file milestones
- Process ends when WT signs off on last Approval signature per Excel file
- Viewing activities in a Log Page
- Reporting

Initial file Excel file publishing and Approval Tracked Activity Log data entry

- Files are dropped in the appropriate folders on the USDA Extranet



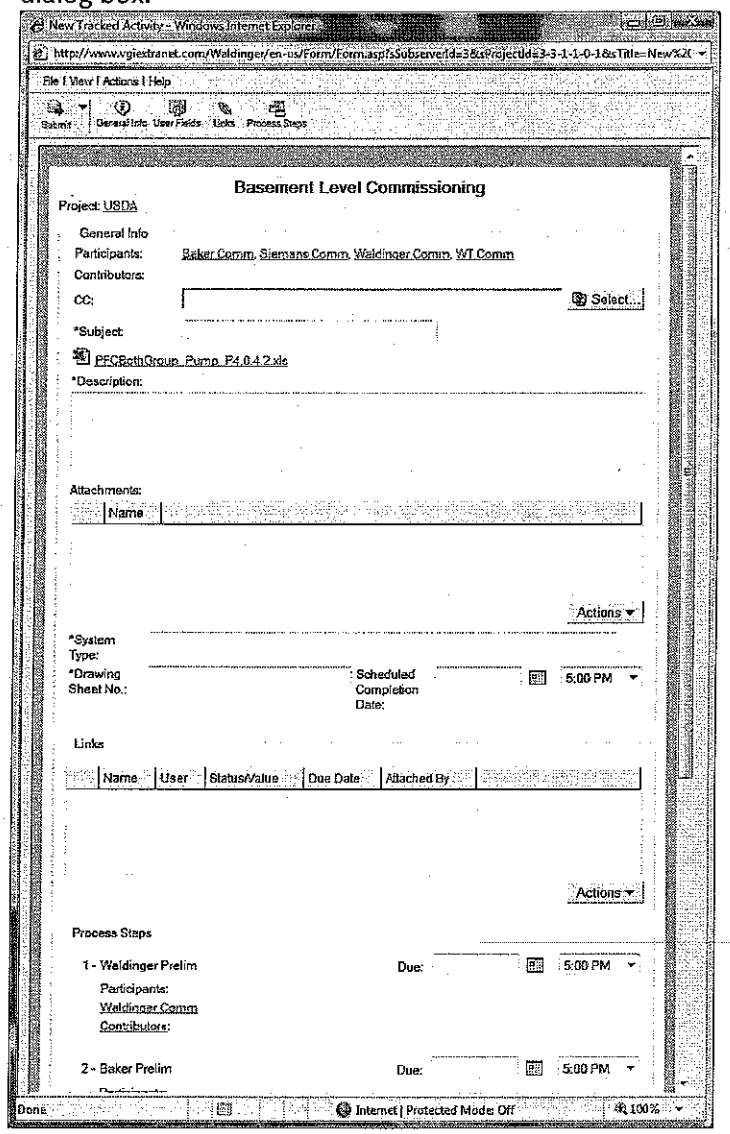
- Select "Publish" from Publish pull down menu in lower right hand corner of file publish window



- Log entry is automatically created to track approval process of the file
  - Select Silent Publish
- Once the file has been published in the preceding step the Extranet Commissioning Business Policy will automatically trigger the creation of a Commissioning Approval Log Tracked Activity.

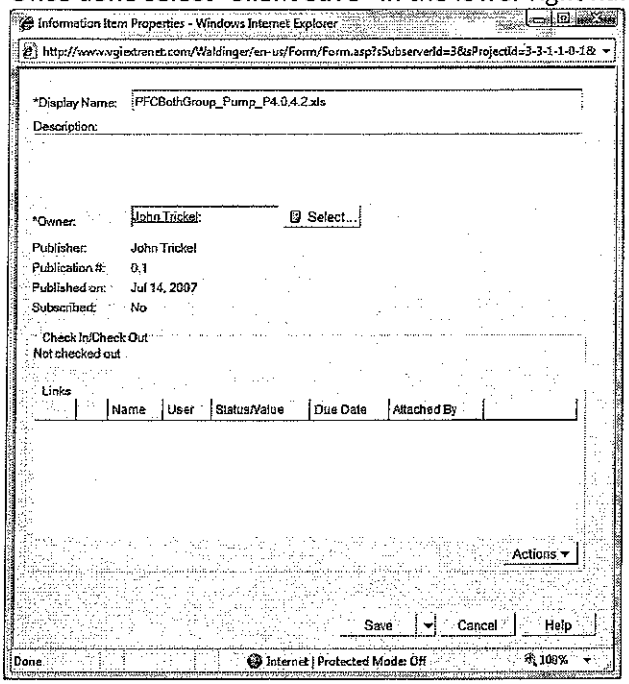
The Approval Tracked Activity Log is necessary to track a specific trade approval sequence per file. There are several data entry inputs once this file Log dialog box comes up.

- CC – Select any Extranet member outside of the Commissioning Group that has access from the list.
- Subject – Equipment Tag Name
- Description – Equipment Tag Number
- System Type – One of (4)..Air Boxes, Air Valves, Reheat Coils, Others
- Drawing Sheet No. – as per the Excel file name
- Scheduled Completion Date – This will be the date as determined by the WT master schedule. For initial data input purposes this entry will be left blank.
- Process Step Due Date – Insert this date if known during initial data entry.
- Select "Silent Publish" from the upper left hand corner of the Tracked Activity Log entry dialog box.



- Once Publishing is complete AND the Approval Tracked Activity Log is created, the Ownership of the file is changed from the original publishing owner to a group name called "Commissioning". This is a necessary step so all trades that are participating in the Commissioning Extranet process are able to check out/in the file for editing.
  - Right click on the file and select "Properties" to bring up the file Properties dialog box

- Select the new owner to be the Commissioning Group
- Once done select "Silent Save" in the lower right hand corner



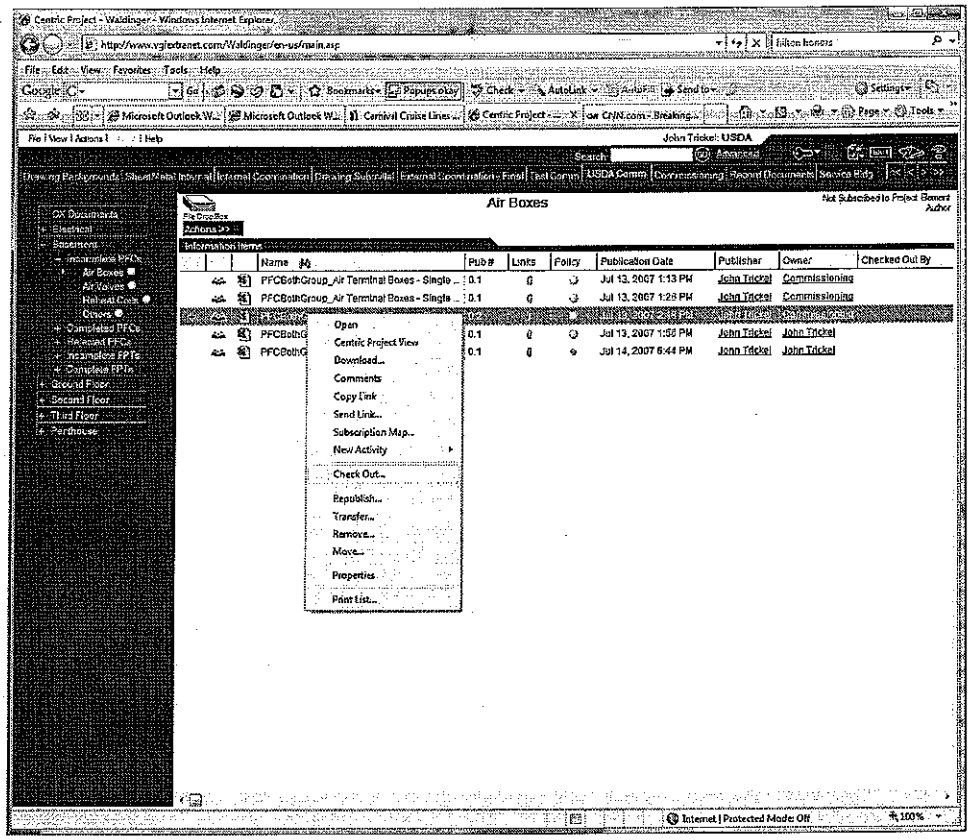
Check In/Out Excel file editing by various trades

Each trade is required to confirm and provide status and sign off of key data points of each piece of equipment as outlined by the Commissioning Trade Manager. To accomplish this it is necessary to check out (initiates a download to your host computer) the Excel file, edit it and Check in (re publish) to the Extranet. Once Checked Out no other trade can check out or download the file. The file can be viewed.

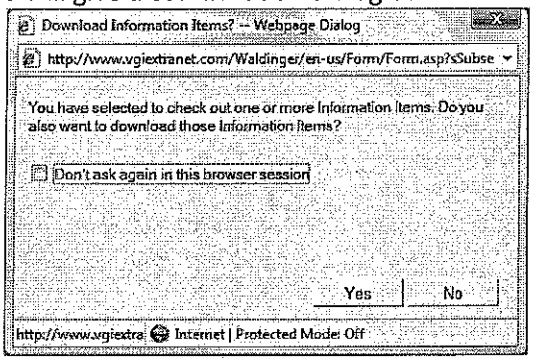
NOTE:

- ***The file located in the Commissioning Folder is only visible to be checked out to the Trades whose Approval (The Comm Log in the DASHBOARD) is in their court. As an example the first Approver in the Dashboard Appoval Log in Waldinger so only Waldinger can Check Out the file for revision. Once Waldinger signs off in the Approval Log the file is now visible to Baker electric as they are second on the Approval list.***
- ***The files, however can be viewed and downloaded anytime by everyone from the Approval Log.***
- ***Any trade can open the Approval Log and "Save with a note" as permanent record of any additional comments.***

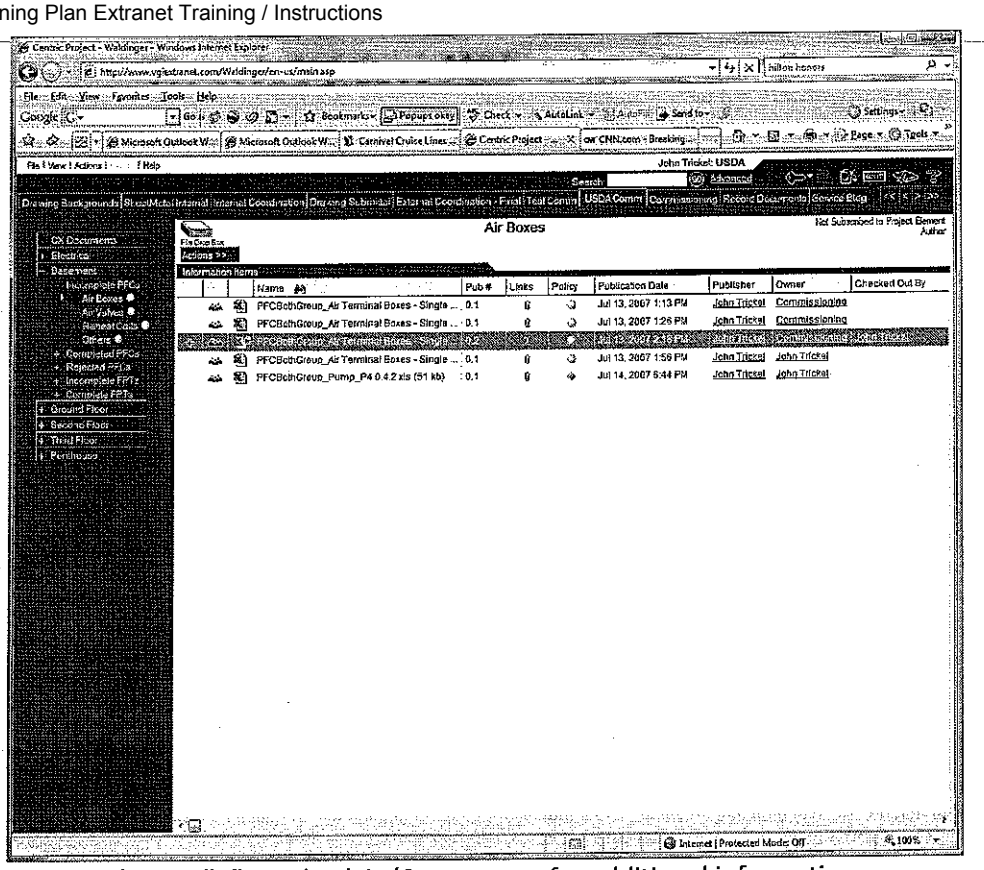
- Any commissioning group participant can check out/in the files to edit. In the Commissioning



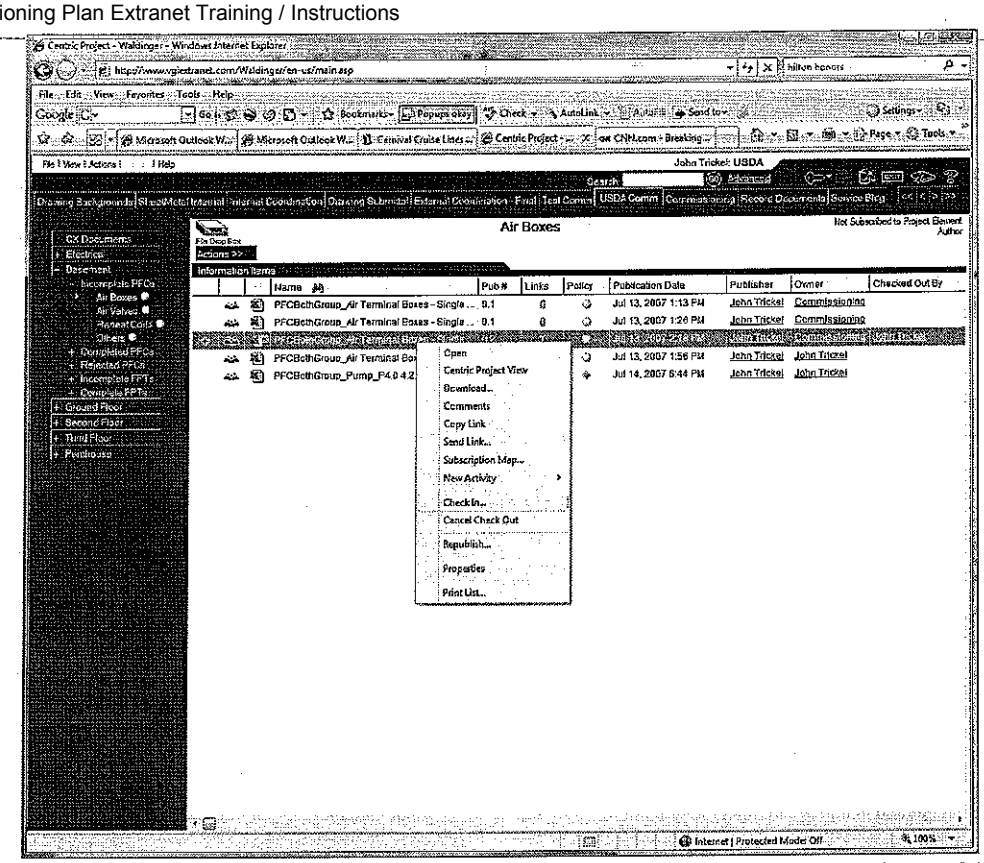
Tab, find the file you wish to Check Out. Right click on the file and select "Check Out" from the list. You will give a confirmation dialog box.



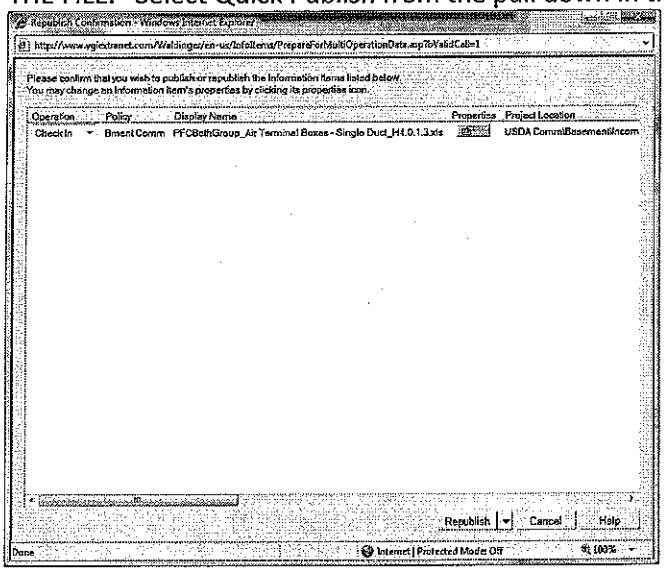
- Select "YES" and then select the location on your network you with to store the file.
- Once checked out the file will show a "paddle lock" icon and list in the display who has possession of the file.



  - See Attachment "A" on Check in/Out process for additional information.
- Check out the file, Edit the file, Check the file back in
  - Once checked out each participant edits the excel file as normal, then checks it back in to the Extranet
  - To Check In select the file and right click and pick “Check In”



- You will then be asked to confirm the location of the file on your network. THIS IS IMPORTANT AS YOU MAY BE REQUIRED TO BROWSE TO THE LOCATION AND SELECT THE FILE. Select Quick Publish from the pull down in the lower right of the dialog box.



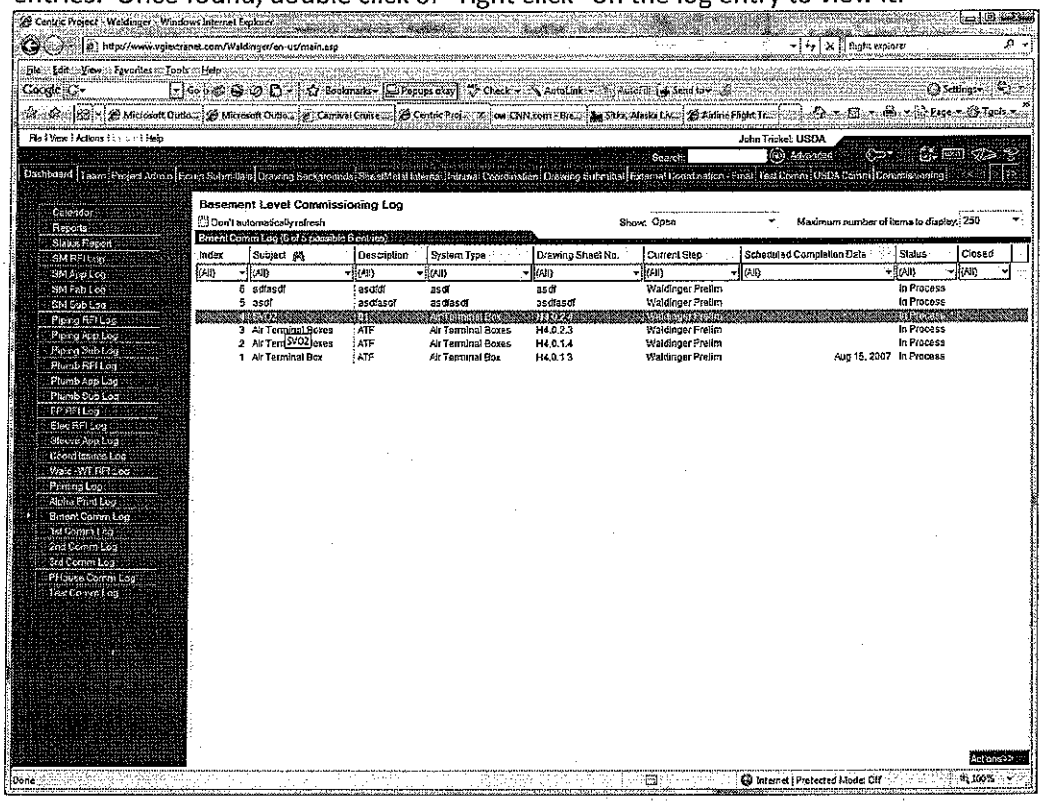
- This completes the Check In process

Trade Approval digital "sign off" of individual Excel file milestones

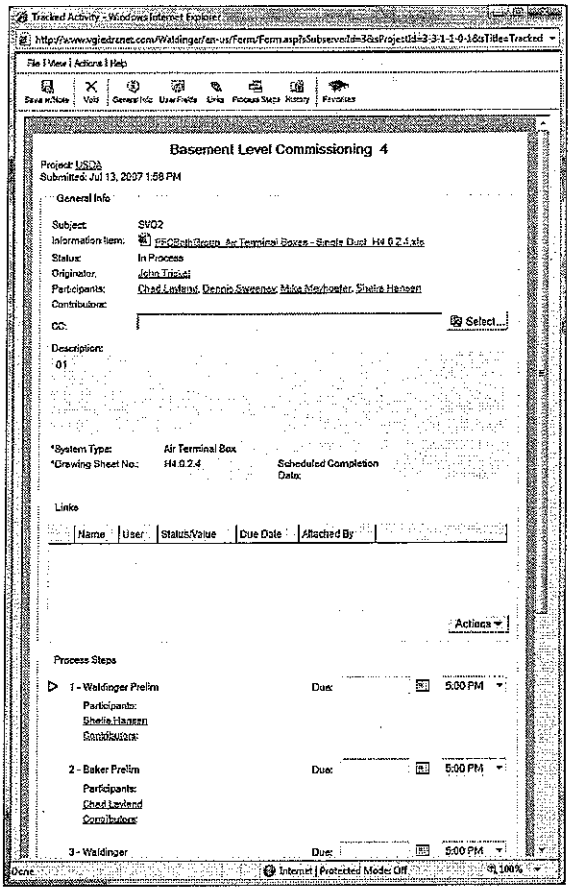
- As files are Checked In and Out various milestones will be reached. As tasks are completed it will be necessary for each trade to "sign off" to move the responsibility to

the next Trade Approvers court. See Attachment "B" for detailed information regarding Approval Tracked Activities.

- Each participant signs off on completed work per Excel file. To do this you navigate to the Dashboard TAB and select the Floor Commissioning log you desire. Scroll thru the various logs entries. Once found, double click or "right click" on the log entry to view it.



- NOTE:
  - Log entries can be updated by anyone at any time by simply opening the Entry and "Saving with a Note". This button is at the top of the Log Entry dialog box. The information is saved as part of the history of the Entry and email notifications are sent out.
- To Approve and advance the Entry to the next Approver simply select the "Approve" at the top of the dialog box.
  - Note
    - **Approving** the step allows the approval process to continue. Once all participants who are required to approve at a step have approved it, the process continues to the next step in the Approval Activity.
    - **Rejecting** the step stops the approval process. The Originator is notified and no one else can approve or reject the Activity. ***DO NOT REJECT ANY ACTIVITY!!***
    - **Recycling** the Activity moves the process back to a previous step (or the current step). All previous approvals from that step forward are removed and the Activity must go through those steps again in order to be approved.
    - **Returning** at a step returns the Activity to the Originator who can then provide further information or make changes to the Activity before resuming it at the step at which it was returned.



- Individual Log Entry remains open until last signature by WT is signed.
- Once WT signs the file is automatically moved from the Incomplete to the Completed folder.

Bulk Update for Tracked Activities

In some cases the same update needs to be made to many Tracked Activities at the same time. Use the following procedure to provide bulk responses to the Tracked Activities. For more information on responding to Tracked

Note: You can perform this transaction from the following locations.

- My Activities tab in My Dashboard
- Activity Log pages on the project's Dashboard tab
- Search Result in My Dashboard

To respond to Activities in bulk

1. View the Activities to which you want to respond from My Activities tab or Activity Log pages.
2. Select the tracked activities, right-click and then choose **Transition**.

   The Tracked Activities Bulk Update dialog box appears.
3. Fill out the Tracked Activities Bulk Update dialog box.

4. The **Save** button is dynamically displayed depending on the e-mail notification setup done by the Project Author in the Project Properties dialog box - General tab.

Save: You will be prompted by the Notification windows before sending the e-mail.

Quick Save: The e-mail notification will be sent automatically to the subscribers.

OK: The Project Author has disabled the notification. No e-mail notification will be sent.

Note: You can configure the **Save** button from the Project Properties dialog box - General tab.

The Send Notification E-mail dialog box appears.

5. Fill out the Send Notification E-mail dialog box.
6. Click **Send All**.

Viewing Activities in a Log page

A Log page lists all Activities of a particular type that have been submitted for a project. Use the Log page to view overview information about each Activity and to view the contents of any listed Activity.

From the Log page, you can sort, view, copy, and send an e-mail link for any listed Activity. In addition, you can customize your view of the log by

- Using the Show box and the Maximum number of items to display box to select which Activities appear in the log (for example, you can choose to see **All Overdue** or **All Open** and to display a maximum of 250 at once)
- Using column filters to select Activities based on column values
- Adding or removing columns to show only the information you are interested in seeing

Activity log pages appear on the Dashboard tab. To view Activities in a Log page, you must have access to the Dashboard tab and to the type of Activity for which you want to view the log.

Tip: To easily see only those Activities for which you are responsible or that otherwise relate to you, use the My Activities tab in the My Dashboard window.

To view a Log page

- On the Dashboard tab, click the Log button for the type of Activity log that you want to view.

The appropriate Activity log page appears in the right side of the window. By default, the Log page displays all open Activities. You can select to see other Activities.

- **To sort the Activities**, click a column heading. To reverse the sort, click the column heading again.
- **To view the contents of a listed Activity**, select the Activity and then choose Open from the Actions menu (or right-click the Activity and then choose Open).
- **To copy a listed Activity** to paste as a link elsewhere in the project, select the Activity and then choose **Copy** from the Actions menu (or right-click the Activity and then choose **Copy**).
- **To send an e-mail message that contains a link to a listed Activity**, right-click the Activity and then choose Send Link.

To select the Activities that appear in the log

- To view a subset of the Activities, select the types of Activities you want to see in the Show box at the top of the page.

- To select the maximum number of Activities that appear on the page at one time, select a number in the **Maximum number of items to display** box at the top of the page.
- To select which Activities to include in the list based on the value in a column in the list, click the drop-down box beneath the column name and select a value or select **(Custom...)** to create your own filter statement.

To select which columns appear on the Log page

1. From the Actions menu, choose **Select Columns**.
2. The Select Columns dialog box appears.
3. Add or remove the listed columns to include the columns you want to show on the Log page.
    i. Note: You cannot remove the Index or Subject columns from the log page.
4. Click **OK**.

Reporting

Reporting templates will be developed once the data entry input is complete.

ATTACHMENT "A"
USDA Extranet

July 12, 2007

Working with Checking Information Items In and Out

Overview: Checking out and in Information Items

If you are a member of a group that owns an Information Item, you can check out the Information Item so that you can prevent other owners of the item from updating it while you are working on it. Other users can view and download a checked out Information Item, but no one else can republish it, check it out, remove, move, or transfer it until you have checked it back in.

While you have an Information Item checked out, you can republish it without checking it in to update the published version while still retaining control over the item.

When you are finished updating the Information Item, you can check it in. Checking in an Information Item republishes it and makes it available to other owners to be checked out and updated..

If you have checked out an Information Item, you can cancel the check out without republishing it so that other users can republish it or check it out.

Notes: You can check out an Information Item only if it is owned by a group.

You cannot check out URL Information Items or structured data Information Items.

Checking out Information Items

If you are a member of a group that owns an Information Item, you can check out the Information Item. When an Information Item is checked out, you can republish it as needed without checking it back in, and other users can view and download the item, but no one else can republish it until it has been checked back in. A checked out Information Item cannot be removed, moved, or transferred.

Notes: You can check out an Information Item only if it is owned by a group and you are a member of the group.

You cannot check out URL Information Items or structured data Information Items.

To check out an Information Item

1. Select the Information Item that you want to check out.
2. From the Actions menu, choose Check Out.

A message appears that asks if you want to download the Information Item.

3. Select whether you want to download the Information Item.
   - To check out the Information Item and download it, click Yes.
   - To check out the Information Item without downloading it, click No.

If you selected to download the Information Item, the Save As dialog box appears so that you can choose where you want to save the Information Item. Click Save to save the Information Item.

The Information Item is checked out. A appears to the left of the item's name and your name appears in the Checked Out By column in the Information frame.

Note: The icon appears next to a checked out item's name only when you are viewing the Information frame. It does not appear in My Dashboard, Search Results, or other places in the project workspace.

Checking in Information Items

When you check in an Information Item, the Information Item is republished and is available to other owners to be checked out and updated.

Note: You can also check in an Information Item by republishing it. For more information, see Republishing checked out Information Items.

To check in an Information Item

1. Select the Information Item that you want to check in.
2. From the Actions menu, choose Check In (or right-click the item and then choose Check In).

The Republish Confirmation dialog box appears.

3. In the Operation column for the Information Item, make sure that Check In is selected.
4. Check in the Information Items. The Republish button is dynamically displayed depending on the e-mail notification setup done by the Project Author in the Project Properties dialog box - General tab.

Republish: You will be prompted by the Notification windows before sending the e-mail.

Quick Republish: The e-mail notification will be sent automatically to the subscribers.

Republish (without the drop-down menu): The Project Author has disabled the notification. No e-mail notification will be sent.

Note: You can configure the Republish button from the Project Properties dialog box - General tab.

The Send Notification E-mail dialog box appears.

5. Fill out the Send Notification E-mail dialog box.
6. Click Send.

Republishing checked out Information Items

If you have checked out an Information Item, you can republish it. When you republish the Information Item, you can choose whether to check it back in or leave it checked out.

Notes: If you are a member of a group that owns an Information Item that is checked out by another group member, you cannot republish the Information Item, but you can publish it as a new Information Item.

If you are a member of a group that owns an Information Item that is not checked out and you republish it but were not the previous publisher, you will see a warning that tells you to check out the Information Item before republishing it.

Use the following procedure to republish an Information Item that you have checked out.

To republish a checked out Information Item

1. Use the Drop Box or the Republish command to republish the Information Item.

The Republish Confirmation dialog box appears.

2. In the Operation column, select what you want to do:
   - To republish the Information Item and leave it checked out, select Republish.
   - To republish the Information Item and check it back in, select Check In.

3. The Republish button is dynamically displayed depending on the e-mail notification setup done by the Project Author in the Project Properties dialog box - General tab.

Republish: You will be prompted by the Notification windows before sending the e-mail.

Quick Republish: The e-mail notification will be sent automatically to the subscribers.

Republish (without the drop-down menu): The Project Author has disabled the notification. No e-mail notification will be sent.

Note: You can configure the Republish button from the Project Properties dialog box - General tab.

The Republish Confirmation Notification dialog box appears.

4. Make any necessary changes to the list of recipients and type the message that you want to send to the recipients in the Notification Text box.

5. Click Send.

Canceling a check out

Canceling a check out removes the checked out status from an Information Item without republishing. For example, you might need to cancel a check out if you checked out the Information Item and then decided that you are not the person to update the item.

You can cancel a check out only for an item that you have checked out, or if you are the project Author or a tab Editor.

To cancel the check out for an Information Item

1. Select the Information Item for which you want to cancel the check out.
2. From the Actions menu, choose Cancel Checkout (or right-click the item and then choose Cancel Checkout).

The Information Item is no longer checked out.

ATTACHMENT "B"
USDA Extranet

July 12, 2007

Working with Commissioning Tracked Activity Log

Overview: Working with Tracked Activities

Tracked Activities (also called Activities) are customized online forms that allow project users to request and communicate information about a project. For example, your project might use Activities to communicate the following information:

- Requests for information (RFIs
- Engineering change orders (ECOs)
- Submittals
- Memos
- Change orders
- Distribution
- Action items
- Assignments
- Approvals
- Purchase orders
- Polls or surveys

You can use Activities to communicate information about your project to all other project users. You can also use Activities to define and enforce a formal process for completing a particular task or project. For example, if you are working on a project that requires specific information to be routed to certain project users in a pre-defined order, you can create an Approval Activity to define the approval steps and associated project users through which the information must pass (and be approved) in order to complete the process.

The My Activities tab in My Dashboard shows you the Activities that you are involved with, either as the creator (originator) or a recipient. The At-A-Glance tab in My Dashboard also shows your Activities that have due dates and that are due to in the date range you select. You have access to your Activities via My Dashboard even if you do not have access to any project workspaces.

In addition, if you have access to any Activity Logs in a project workspace, you can see overview information about each Activity that has been sent for each type, including the names of the participants, its current state, when it was submitted, and when it is due.

If you have access to the Project Reports page, you can see the Project Statistics report, which gives statistical information about the Activities for which you can view Logs. Project users with permission to create new project reports can create custom reports based on Activity data for the current project.

Activities differ from ordinary e-mail in several important ways:

- They are tracked within the project workspace rather than through a separate e-mail application (project users also receive e-mail notification about Activities).
- Since Activities are part of a project workspace, they stay with and relate directly to the project data and are archived along with project data.

Approval Activities

An Approval Activity specifies the process for routing a piece of project information (often for approval, but also for review or other reasons) through one or more project users. This type of Activity specifies the information that needs to be routed, the people who need to see it, the order in which they need to see it, and (optionally) the date by which they need to enter a response about it. For example, an engineering change might need to be approved by a project manager, one or more department managers, and then a vice president.

The person who creates an Approval Activity (the Originator) specifies the information that needs to be approved.. When the Participants listed in the first step of the approval process receive the Activity, they can choose to approve, reject, recycle, or return the Activity.

- **Approving** the step allows the approval process to continue. Once all participants who are required to approve at a step have approved it, the process continues to the next step in the Approval Activity.
- **Rejecting** the step stops the approval process. The Originator is notified and no one else can approve or reject the Activity. **DO NOT REJECT ANY ACTIVITY!!**
- **Recycling** the Activity moves the process back to a previous step (or the current step). All previous approvals from that step forward are removed and the Activity must go through those steps again in order to be approved.
- **Returning** at a step returns the Activity to the Originator who can then provide further information or make changes to the Activity before resuming it at the step at which it was returned.

The project Author can create two different types of Approval Activity:

- In a **standard** Approval Activity, the project Author defines all of the routing information for the Activity (the approval process steps and the Participants for each step). When the Originator creates a standard Approval Activity, he or she specifies the information to be approved and the due dates for each step (if necessary), but cannot change the number of steps, the order of steps, or the Participants in each step.

- You can create links between Activities and other project information. For example, you can link Information Items or Project Elements to Activities and you can link one Activity to another.
- Activities appear in My Dashboard so that you can see all project-related tasks and messages in one location.
- If you have access, you can view the status and other information about Activities on the Dashboard tab's Activity Log pages and on the Project Reports page.

Your project's Author creates Activity types for your project. When creating a new Activity type, the Author decides what information is included in each Activity, which information project users are required to enter for the Activity, and which project users can participate in the Activity.

Viewing Activities

Activities appear in the following places in your project workspaces:

- At-A-Glance tab in My Dashboard

  Activities that have due dates appear in the Important events list on the At-A-Glance tab if the date range you have selected includes the due dates for the Activities.

- My Activities tab in My Dashboard

  On the My Activities tab, you can choose to see only your current Activities (those that require an action from you or those that have been updated since the last time you viewed them) or all Activities in which you have been involved. You can also select the projects for which you want to see Activities and can use or create column filters to display any subset of your Activities (for example, only those with a status of In Process).

- Activity Log pages on the project's Dashboard tab

  If you have access to the Log page for the type of Activity you want to view, you can see a list of all Activities of that type that have been submitted. On the Activity Log page, you can choose to see only certain Activity (for example, only those that are open, or only those that are overdue). You can also use or create column filters to display any subset of the Activities of that type (for example, only those with a specific Responsible User).

- Calendar page on the project's Dashboard tab

  If you have access to your project's Calendar page on the Dashboard tab, you can choose to see all of your Activities that have due dates (those for which you are a Responsible User) or all Activities that have due dates and whose Log pages you have access to (this includes Activities for which you are not the Responsible User).

In any location, you can view an Activity by opening it.

To open an Activity for viewing

- To open an Activity in My Dashboard or an Activity Log page, select the Activity, and then choose **Open** from the Actions menu (or right-click the Activity and then choose **Open**, or double-click the Activity).
- To open an Activity on the Calendar page, click the link for the Activity (or right-click the Activity and then choose **Open**).

Updating Activities

Updating an Activity allows you to add or change some of the information in the Activity without also performing another transaction with the Activity (for example, responding, approving, rejecting, or transferring). Updating an Activity keeps the Activity in the same state.

> **Note:** The information that you can update depends on the type of Tracked Activity, its status, and your role with regard to the Activity. For example, if you are a CC recipient of an Activity, you cannot update any information in it; no one can update a Poll Activity.

For example, if you are working on an Approval Activity, you may want to add a note to the Activity or add a link or attachment without yet approving or rejecting the Activity. You can approve or reject the Activity later by responding to it. If you are responsible for an Assignment Activity, you update it until

you change its status to 100%, at which point it is removed from your worklist and it appears in the Originator's worklist to update.

When you update an Activity, a brief description of the update appears in the History section of the Tracked Activity dialog box. You can also choose to add your own note to the standard history entry by choosing the **Save with Note** command.

To update an Activity

1. View the Activity that you want to update.

   The Tracked Activity dialog box appears.

2. Update the Tracked Activity.

   Note: For information about adding links when you update an Activity, see Adding links to Activities.

3. To save your changes without adding your own note to the Tracked Activity's history, choose **Save** from the Activity's File menu. Your changes are saved and the Tracked Activity dialog box remains open so that you can make other changes. When you are finished making changes, close the Activity dialog box by choosing **Close** from the Activity's File menu.

   To save your changes and add a note to describe your change, choose **Save with Note** from the Activity's File menu (or click the **Save w/Note** button on the Activity's toolbar). The Update Tracked Activity dialog box appears. Type the note you want to include in the Activity's history and add any attachments you want to include.

   The **Save** button is dynamically displayed depending on the e-mail notification setup done by the Project Author in the Project Properties dialog box - General tab.

   Save: You will be prompted by the Notification windows before sending the e-mail.

   Quick Save: The e-mail notification will be sent automatically to the subscribers.

   OK: The Project Author has disabled the notification. No e-mail notification will be sent.

   Note: You can configure the **Save** button from the Project Properties dialog box - General tab.

   Your changes are saved and the Tracked Activity dialog box closes.

Responding to Activities

When you receive a new or updated Activity, the project workspace lets you know by making the following changes to the project workspace:

- The  icon in the toolbar turns **bold** (this icon also turns red if any of your Activities are overdue).
- The  icon next to the associated project on the Projects tab in My Dashboard turns bold (this icon also turns red if any of your Activities are overdue).
- The My Activities tab in My Dashboard turns bold (the tab also turns read if any of your Activities are overdue).
- New or updated Activities appear in bold on the My Activities tab in My Dashboard (overdue Activities also appear in red).

Depending on the type of Activity and your involvement with it, these indicators may mean simply that the Activity is new and unread, or it may mean that you need to respond to the Activity.

The type of Activity and its current state determine what type of response is required. For example, if you are a recipient of a Request/Response Activity, you might need to send a text reply to the Activity. If you are the person who created that Activity and a confirmation is required after a response, you might need to confirm or reject the response.

To respond to an Activity

1. View the Activity to which you want to respond.

   The Tracked Activity dialog box appears.

2. Update the Tracked Activity with any new information you need to add (for example, specify values for User Fields, add or remove links, etc.).

3. From the File or Actions menu, choose the transaction that you want to perform (for example, **Respond**, **Approve,** or **Reject**):

   - To perform a transaction that moves the responsibility for the Activity to another user (for example, responding to a Request/Response Activity or approving an Approval Activity), choose the transaction from the Activity's Actions menu.
   - To save your updates to the Activity without moving the responsibility for the Activity to another user, choose **Save** or **Save with Note** from the Activity's File menu.

   Note: If you are the Responsible User for an Assignment type Activity, the only type of transaction you can perform on the Activity is to update it and then choose **Save** or **Save with Note** from the File menu.

   If the transaction you chose allows you to enter a note into the Activity's history, the appropriate transaction dialog box appears. Otherwise, the Tracked Activity dialog box closes.

4. Type the note that you want to include in the Activity's history and add any attachments you want to include.

5. The **Save** button is dynamically displayed depending on the e-mail notification setup done by the Project Author in the Project Properties dialog box - General tab.

   Save: You will be prompted by the Notification windows before sending the e-mail.

   Quick Save: The e-mail notification will be sent automatically to the subscribers.

   Save (without the drop-down menu)**:** The Project Author has disabled the notification. No e-mail notification will be sent.

   Note: You can configure the **Save** button from the Project Properties dialog box - General tab.

   The Send Notification E-mail dialog box appears.

   Notes: If you are responding to an Approval type Activity that requires authentication for each action, the Reauthenticate dialog box appears before the notification dialog appears. Enter this information and then click **OK** to proceed.

   If your response to an Approval Activity would move the Activity to the next step in the approval process and one or more required fields have not yet been filled out for the Activity, a message appears that indicates which fields require a value. The Activity cannot proceed to the next state until the listed fields are updated by users who have access to edit those fields.

6. Type the note (if any) that you want to add to the notification about your response to the Activity.

7. Click **Send.**

Printing Activities

You can print any Tracked Activity that you can view, regardless of its status. You can print an HTML version of the Tracked Activity, or you can open it in Microsoft Word or Adobe Acrobat and then print it from those applications.

Use the following procedures to print an HTML version of an Activity or to open The Activity in another format and then print it.

> **Note:** To open an Activity in a different format, you must have Microsoft Word or Adobe Acrobat installed on your computer.

Printing an Activity

1. View the Activity that you want to print.
2. From the Activity's File menu, choose **Print**.

   The Print dialog box appears.
3. Select the printer and print options you want to use.
4. Click **Print**.

Opening an Activity in Word or Acrobat

1. View the Activity that you want to open in Word or Acrobat.
2. From the Activity's File menu, choose **Open as Word** or **Open as PDF**.

   The Activity opens in the application you chose.
3. From the application's File menu, choose **Print**.