

EFCOG Best Practice #144

eUSQ - Computer Applications to Expedite the USQ Process

1/19/2013

Facilities: Sandia National Laboratory (SNL) and Oak Ridge National Laboratory (ORNL)

Best Practice Title: *eUSQ – Computer Applications to Expedite the USQ Process*

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Brief Description of Best Practice:

The Unreviewed Safety Question (USQ) process can be improved, becoming more efficient and effective. This best practice implements one of the recommended actions to improve efficiency of the USQ process implementation. The Electronic Unreviewed Safety Question (eUSQ) System is an electronic tool that was developed to simplify the existing USQ paper-based system and reduce the potential for errors by allowing personnel to electronically follow the Unreviewed Safety Question (USQ) Screening Checklist and Unreviewed Safety Question Determination (USQD) Worksheet processes and generate the required forms. The process described herein and the detailed information is based on the electronic process applied at Sandia National Laboratory. The High Flux Isotope Reactor (HFIR) at Oak Ridge National Laboratory (ORNL) applies a similar process, but may differ in the details presented here.

The purpose of eUSQ. This was developed to electronically document the USQ process.

- Used to enter, store, process, and access USQ form entries.
- Augments, does not replace, the current USQ process.
- Intended to reduce manual effort, not mental effort.
- Reduces opportunity for human error through well-defined logic restraints, roles, and responsibilities.
- End result (document) is identical to approved form.

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- Automatically ensures proper record retention.

This system was designed to automate workflow control while providing the proper access controls (i.e., access only to qualified preparers, reviewers, approvers, and specially designated personnel such as the local site office safety basis counterparts). The system was also designed to allow users to track all USQ screens and USQDs in process in one place improving configuration management of the process. It provides for creation, editing, revision, copying, and cancellation USQ documents. For completed documents, eUSQ automatically transmits a PDF record for 75 year document retention. eUSQ has been integrated into the USQ Process and implemented at Sandia and ORNL HFIR.

Features of eUSQ.

- Uses electronic signatures.
- Auto-email to users for workflow actions.
- Safety basis document references pre-loaded for each facility in USQD worksheet.
- Ability to attach files to any USQ document.
- Copy, revise, and cancel capability for existing entries.
- DSA page change checkbox allows users to track entries that may have impact to their DSA to assist in annual update process.

As with the conversion of any paper-based system to an electronic system, several unforeseen problems were encountered that had to be solved in order to meet the requirements established for this system. This paper highlights the most important issues and provides points of consideration for those who are planning to automate their USQ or similar processes. The areas discussed in this paper are software documentation, developing an automated process, software platform, consideration for administrative features, effect of code changes on software processes, and software usability.

Why the best practice was used:

Process Improvement, Compliance, and Improved Efficiency. Issues were identified during past periodic USQ assessments that were related to inconsistencies on how the USQ forms were completed and inadvertent modifications to the forms. It was believed that development and use of an automated system would prevent reoccurrences of these events and to improve overall consistency and application of the USQ process. The practice was also applied to improve efficiency of the process.

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What are the benefits of the best practice:

Sandia. The Electronic Unreviewed Safety Question (eUSQ) System is an electronic tool that was developed to simplify the existing USQ paper-based system and reduce the potential for errors by allowing personnel to electronically follow the Sandia Unreviewed Safety Question (USQ) Screening Checklist and Unreviewed Safety Question Determination (USQD) Worksheet processes and generate the required forms. This system was designed to automate workflow control while providing the proper access controls (i.e., access only to qualified preparers, reviewers, approvers, and specially designated personnel such as the local site office safety basis counterparts). The system was also designed to allow users to track all USQ screens and USQDs in process in one place improving configuration management of the process. It provides for creation, editing, revision, copying, and cancellation USQ documents. For completed documents, eUSQ automatically transmits a PDF record for 75 year document retention.

As with the conversion of any paper-based system to an electronic system, several unforeseen problems were encountered that had to be solved in order to meet the requirements established for this system. This paper highlights the most important issues and provides points of consideration for those who are planning to automate their USQ or similar processes. The areas discussed in this paper are software documentation, developing an automated process, software platform, consideration for administrative features, effect of code changes on software processes, and software usability.

At Sandia, the anticipated benefits are approximately \$64k in annual cost savings and schedule efficiency gains of 25% once fully implemented. As stated above, the primary intent of creating this system was to provide consistency and reduce trends that were identified as issues in previous USQ assessments. Though cost savings was not the primary goal, modest cost savings are being realized. It's also worth noting that a pilot was not necessary because the electronic tool implements an approved USQ process. Vigorous testing was performed to ensure proper operation of the tool.

Information from eUSQ for the initial year period was compiled. To estimate savings and efficiency gains, qualified USQ preparers using the eUSQ System were surveyed for their perception regarding preparation time for both simple and complex evaluations using both paper forms and the eUSQ System. Based on the information provided, estimated completion times for simple and complex screening checklists and USQDs were derived. Additionally, consideration for complexity occurred via examination of the detailed descriptions of the change and the bases to support the answers to the screening checklist and USQD questions.

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During the first year of use at Sandia, 284 screening checklists and 169 USQDs were performed at the six nuclear facilities. Of the 284 screening checklists performed, 7% were categorized as complex screens and of the 169 USQDs, 34% were categorized as complex USQDs. Of the 169 USQDs, 10% were in regard to a change in the facility, 84% for changes to procedures, 4% for new activities, and 2% for PISA-related USQDs. The majority of time saved was in preparation of the simple screening checklists (35% of total savings) with preparation of complex and simple USQDs coming in at a close 2nd and 3rd place (31% and 29% of total savings respectively). See Appendix 1 for additional details.

ORNL HFIR. At ORNL's HFIR, the process electronic process has been in place for a number of years. In 2011, 434 USQDs and USQD Screening Worksheets were handled by the electronic system. Tracking and savings relative to paper USQ process is not available. Reverting to a paper process, however, would certainly be a large loss in efficiency and potentially could impact operations.

The ORNL HFIR facility is a complex facility with a large documented safety analysis and a mature and highly integrated electronic system of work control and documentation. It was a natural part of that development process for the electronic USQ process to be a part of that evolution. Other nuclear facilities at ORNL do not have that same level of complexity and electronic integration, and consequently, an integrated eUSQ process has not been established for these facilities on cost/benefit considerations. Based on those cost/benefit considerations, another approach was utilized. A simple procedure was established at ORNL for an electronic signature process using Microsoft Office Word that is sometimes applied to approval of USQDs applicable to these nonreactor nuclear facilities. This can be particularly helpful in cases where multiple signatures are required of those in widely separated locations.

The USQ Subgroup believes that the proposed recommendations will effectively streamline the process while maintaining the necessary rigor to ensure the proposed activities that required DOE approval, obtain that approval.

What problems/issues were associated with the best practice:

Several lessons learned were discovered during development and initial use of the eUSQ system. These lessons illustrate both the difficulty to preclude problems that the eUSQ user will encounter, but also illustrate the system that is in place to identify and improve the system to enhance usability. Also, the lessons learned will provide additional thought for those who will be implementing their USQ or similar process in the future. Detailed lessons learned are can be found in Appendix 4.

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At Sandia and ORNL, process implementation was decidedly successful. The use of eUSQ is achieving the goals of improving consistency. In addition, personnel have supplied positive feedback in that they prefer using the automated system over completing the paper forms.

Optimal implementation of this best practice can be further improved by increasing the comfort level of personnel in this new process and expediting the learning curve. Sandia applied lessons learned during development of training material to cover a wide range of topics that experts may encounter. Example training material from Sandia can be found in Appendix 3.

Simple processes such as the USQ process can become complex for an electronic tool.

- Lessons learned illustrate the difficulty to preclude problems that will occur during software development and maintenance.
- Additional documentation will reduce (but not preclude) additional effort of re-engineering or significant impact to the end user during the software lifecycle resulting in an overall cost savings.
- Communication of these lessons learned should help to provide additional thought for those who will be implementing their USQ or similar process in the future.

During development of the Sandia eUSQ System, the topics regarding the use of electronic signatures and storage of electronic documents were discussed among the participating organizations. For signatures, it was concluded that the use of electronic signatures met the applicable requirements. The eUSQ development team independently reached the same conclusion via research of the various CFR and DOE requirements for creation and management of records.

Regarding document retention, the Sandia eUSQ System does not store the officially-controlled records for meeting document retention requirements because another organization was already responsible for performing this task. The eUSQ System was developed to electronically provide the USQ evaluations to the Sandia records management organization for document retention.

In regard to other site's consideration of the eUSQ process, DOE HSS clarified to the USQ Subgroup that as long as the overall issue of a site's electronic document retention process has been resolved between the local DOE and contractor, then electronic records are acceptable for USQ documents (see USQ Subgroup meeting minutes for additional information).

How the success of the Best Practice was measured:

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Success was gauged by two measures at Sandia. First, by looking at eUSQ compliance to requirements (assessments) when implemented, and second, by the degree of implementation at the site.

One assessment of USQDs created in eUSQ was performed by Sandia. When compared to the previous assessment for USQ evaluations performed on paper, observations and findings were reduced by 60%. It is difficult to conclude with a high level of confidence that this reduction was solely due to the use of eUSQ, but the results are nevertheless promising.

At Sandia, the electronic evaluations are tracked at the facility level. The estimated utilization for Sandia is 100% (i.e., all evaluations are performed with eUSQ). The facilities have the ability to revert to the use of paper forms in the event of a serious server failure; however this has not yet been necessary.

At ORNL's HFIR, the electronic system is used 100% and has been uniformly applied for a number of years without significant issues.

Description of process experience using the Best Practice:

Use of eUSQ may significantly increase the efficiency of the USQ Process implementation. The eUSQ System can also facilitate the safety basis annual update process. A checkbox allows the preparer to designate those changes that also result in a DSA page change. This reduces the amount of time required for an annual update to review the USQ evaluations.

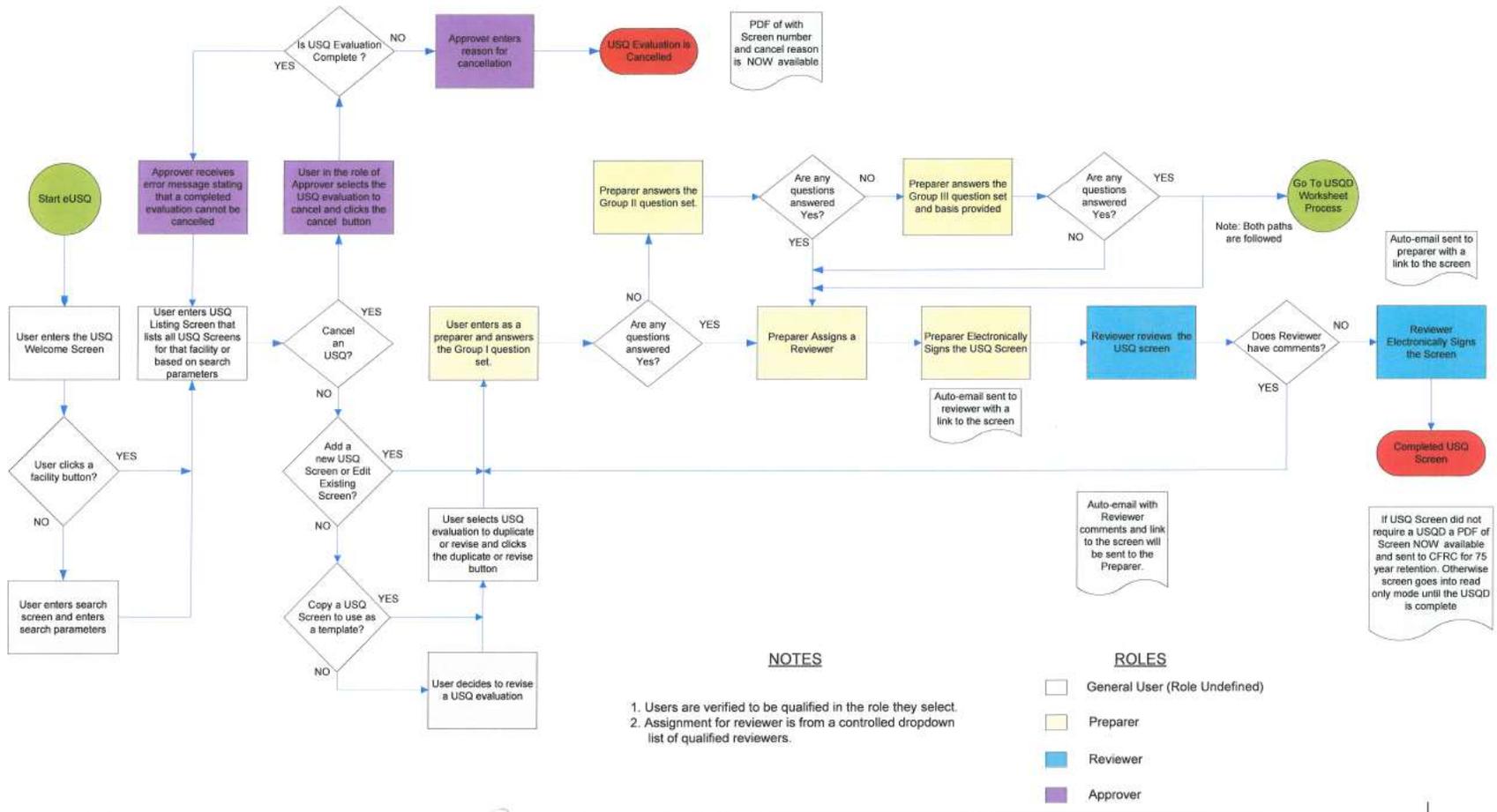
The eUSQ System incorporates a screening checklist and USQD form modeled after the USQD questions in 10 CFR 830 and DOE G 424.1-1B. The screening checklist questions implement the Sandia USQ procedure that is approved by the Sandia Site Office. The forms produced by eUSQ are identical to the paper forms. Once the evaluation has been completed, the eUSQ system automatically sends the completed evaluation to the records office for record retention.

To facilitate the review process, eUSQ provides a field for the reviewer and/or approver to document their review comments. A button is provided to allow them to transmit their comments to the preparer via an email message. In addition, when the reviewer or approver signs the evaluation, an email message is sent to the preparer. Status of the evaluation can be determined at any time via the eUSQ listing page.

Figures 1 and 2 provide an example of how the eUSQ is used for the USQ Process. Example eUSQ forms can be found in Appendix 2.

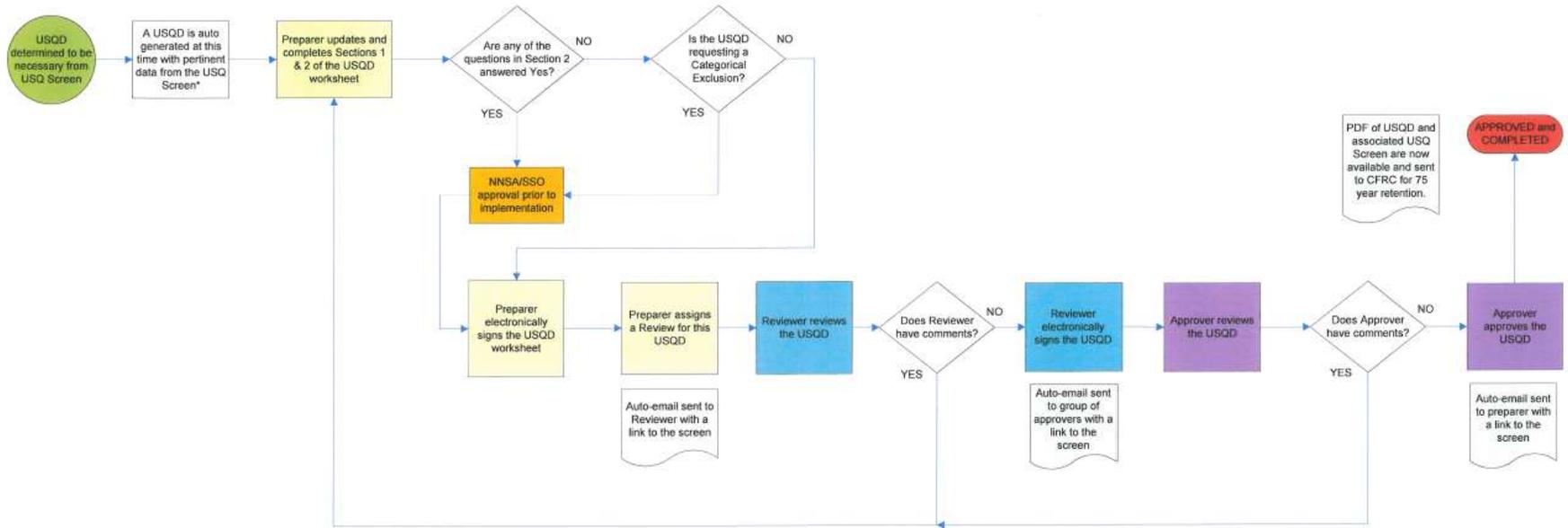
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Figure 1. eUSQ Process for Completing a Screening Checklist.



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Figure 2. eUSQ Process for Completing a USQD.



NOTES

1. Users are verified to be qualified in the role they select.
2. Assignment for reviewer and approver is from a controlled dropdown list of qualified reviewers and approvers.

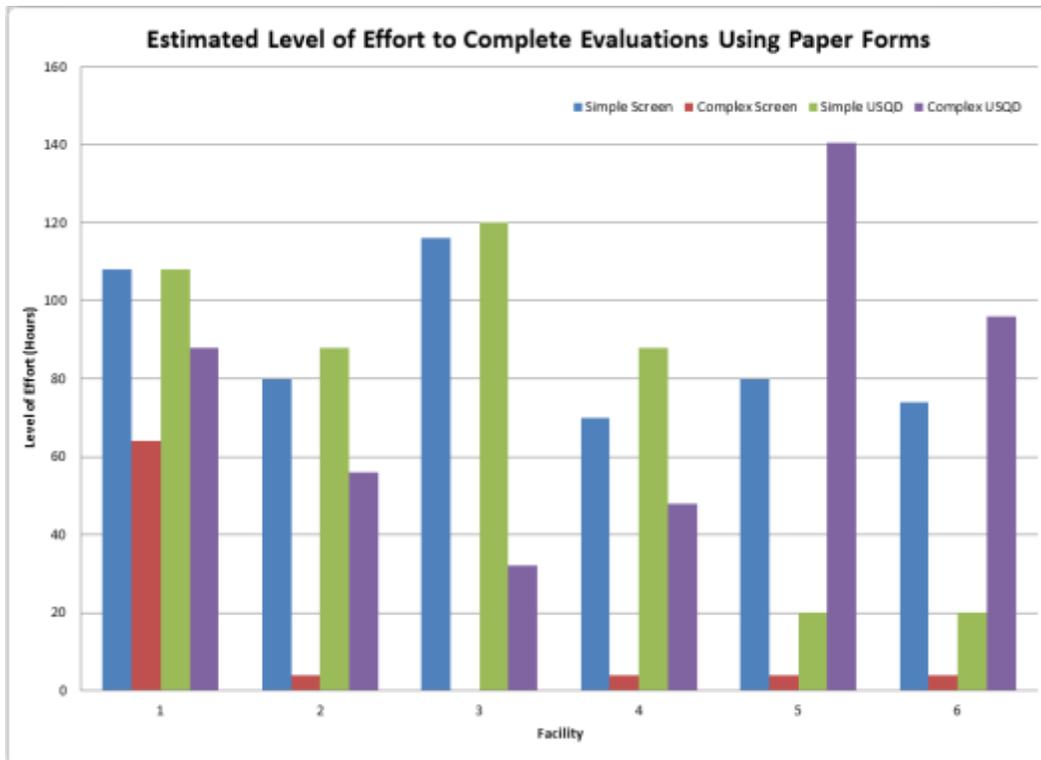
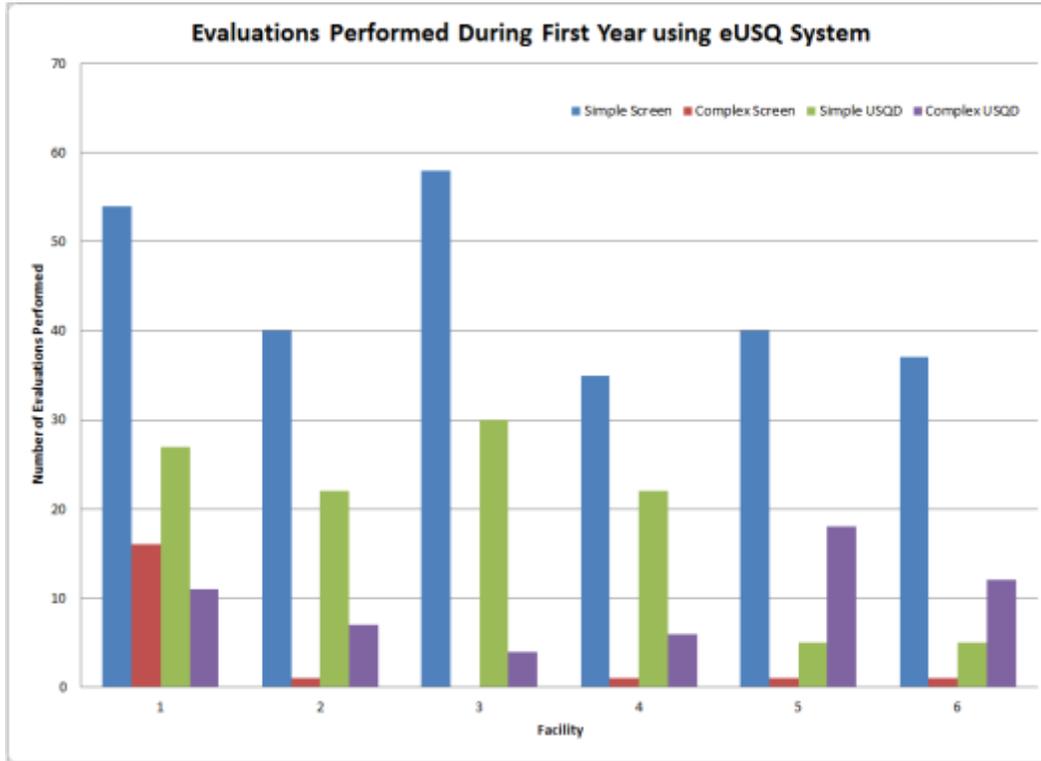
* A USQD that was created by revising or copying another USQD does not get data from the screen. The data from the originating USQD is retained.

ROLES

- General User (Role Undefined)
- Preparer
- Reviewer
- Approver

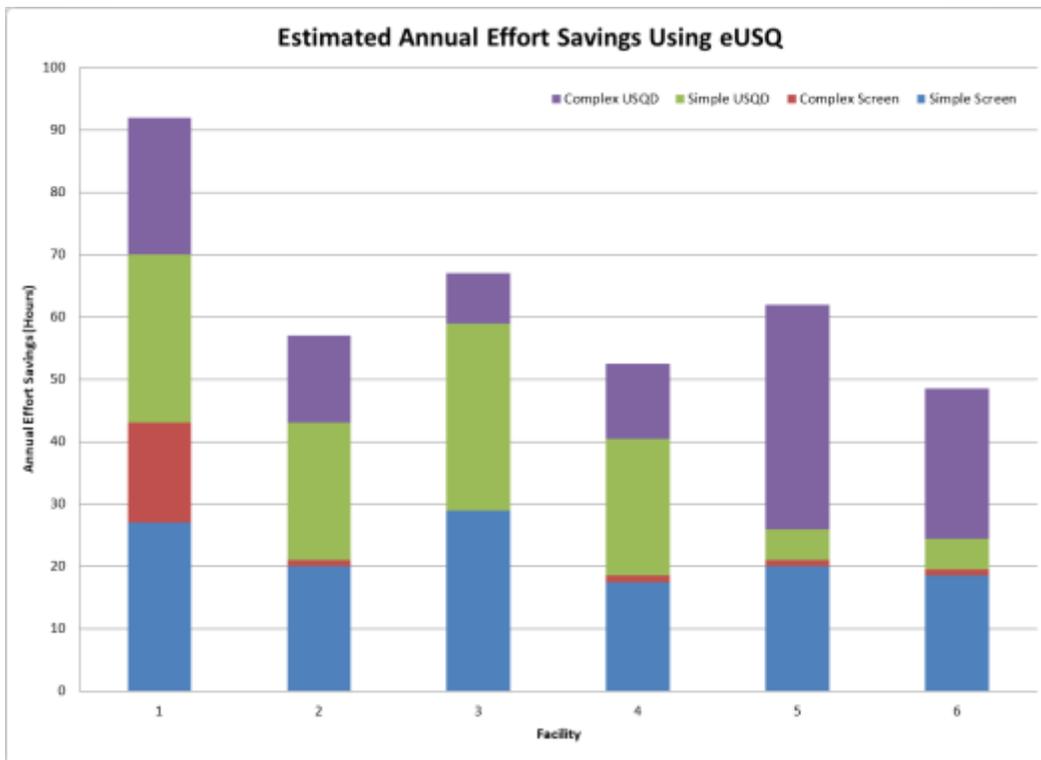
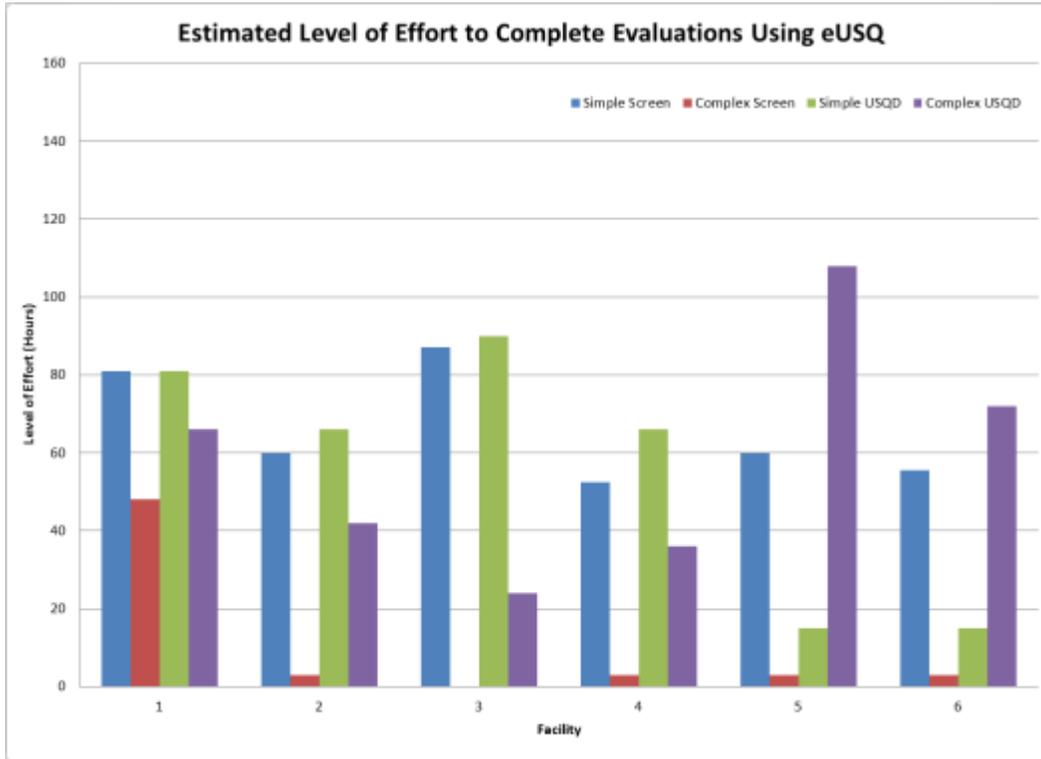
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Appendix 1: Sandia Data for Evaluations Performed During First Year Using eUSQ System and Implementation Status



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Appendix 1: Sandia Data for Evaluations Performed During First Year Using eUSQ System and Implementation Status (cont'd)



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Appendix 1: Sandia Data for Evaluations Performed During First Year Using eUSQ System and Implementation Status (cont'd)

Twelve-Month Snapshot – What have we learned for development and deployment?

- Initial development met requirements for eUSQ System to comply with USQ procedure
- Requirements verified via rigorous testing:
 - Alpha – Ensure requirements from Test Plan were met
 - Beta – End-user testing for usability
- Multilayer environment used for testing and production
 - Development server area for development
 - QA server area for testing
 - Production server for eUSQ System
- Generally implementation went smooth
 - Training provided prior to implementation
 - New potential features identified to increase usability
 - Experienced minor issues with third-party software and corporate server

Twelve-Month Snapshot – What have we learned regarding implementation and use?

- Some implementation / lessons learned issues. See Appendix 4 for Sandia eUSQ lessons learned.
- Minor (short-term) outages due to issues with 3rd party software.
- Some lag on updating of safety basis document list (which is auto-populated in USQD).
- Minor issues on handling issues identified in the Sandia Bugs and Enhancement Entry System (BEES).
- Positive improvements to increase usability have been identified.
- Incorporating lessons learned (as applicable) into next USQ Procedure and eUSQ System.

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Appendix 1: Sandia Data for Evaluations Performed During First Year Using eUSQ System and Implementation Status (cont'd)

Twelve-Month Snapshot – Comparison to Expectations

- With beta testing and user orientation course, eUSQ system has short learning curve.
- Though minor outages occurred, eUSQ has had a high availability for use.
- Automated features streamlined time to prepare, review, and approve an evaluation
 - Users can access system from remote locations
 - Electronic notification for reviewer and approver
 - Ability to electronically locate and view past evaluations
 - Ability for site office to view completed evaluations
- Users are satisfied with using this electronic tool

Sandia eUSQ System – Path Forward

- Revision 1 – updating eUSQ System with suggested improvements
 - Export feature to export USQ listing to Excel spreadsheet.
 - Preparer, reviewer, approver notified via email if they are replaced.
 - Report features for USQ evaluator requalification.
 - Other miscellaneous suggested improvements.
- Linking eUSQ System to eUSQ Information Center
 - eUSQ/USQ documentation (e.g., procedure)
 - What's New to explain new features
 - How-to information
- Revision 2 – updating eUSQ System once revised USQ Procedure is Approved by Site Office

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Appendix 2: Example Sandia eUSQ Worksheets and Screenshots

Page from Screening Checklist

NP 2007-USQ (05-2008) [www.nrc.gov](#)

USQ Screening Checklist

Note: This form is associated with [CPR400.1.1.14/IGN470080](#), Implementing the Unreviewed Safety Question (USQ) Process for Nuclear Facilities.

USQ Screen # _____

Facility name: _____ Date: _____

Detailed description of change: _____

The following questions determine which proposed changes may be immediately screened out and which require preparation of USQD documentation. These questions are placed in three sub-groups: Group I, Group II, and Group III. The answers to the questions in the sub-groups will necessitate different actions by the evaluator of the proposed change.

Group I: If the answer to any of the questions below is YES, the change does not require further processing in the USQ process and does not require NNSA/SSO approval. The summary at the end of this form needs to be completed with the results of the screening, and signed by the USQ screening preparer and independent reviewer.

If the answer to all of the questions below is NO, then the proposed change will require evaluation using the Group II questions in this form. See GN470080, Section 4.2.2.1, "Group I," for detailed guidance.

a. Is the change covered by a NNSA/SSO approved categorical exclusion? If the question is answered "Yes," identify the categorical exclusion and the NNSA/SSO approval date. Categorical Exclusion Document Number: _____ Approval Date: _____	<input type="checkbox"/> Yes <input type="checkbox"/> No
b. Is this change completely enveloped by a previous USQD? If the question is answered "Yes," identify the USQD and the approval date. USQD Number: _____ Approval Date: _____	<input type="checkbox"/> Yes <input type="checkbox"/> No
c. Is this a proposed action that involves the installation of an item that is an exact replacement (i.e., same manufacturer, same model number, etc.)?	<input type="checkbox"/> Yes <input type="checkbox"/> No
d. Is this a proposed action or maintenance action that involves the installation or replacement of an item that is on the facility approved equivalent parts list? If this question is answered "Yes," identify the supporting engineering evaluation which provides the equivalency determination. Document Number: _____ Document Title: _____	<input type="checkbox"/> Yes <input type="checkbox"/> No
e. Is this a non-conforming part restored to become compliant with the requirements (i.e., the disposition of the non-conformance report is "reject" or "rework")?	<input type="checkbox"/> Yes <input type="checkbox"/> No
f. Is this a corrective action for a condition that involves a restoration modification (return to original condition), as described in the DSA? If not, the as-found condition must be considered a PISA and a USQD performed.	<input type="checkbox"/> Yes <input type="checkbox"/> No

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Page from USQD Form

NP 2007-USQ (05-2008) [www.nrc.gov](#)

SECTION 2 – Unreviewed Safety Question Determination (USQD)

NOTE: Use [Attachment B](#) of document CPR400.1.1.14/IGN470080, "USQ Question Set Guidance," as reference for additional guidance.

1. Could the proposed change increase the probability of an accident previously evaluated in the facility's existing safety analyses? Explain your answer below.	<input type="checkbox"/> Yes <input type="checkbox"/> No
2. Could the proposed change increase the consequences to workers or the public of an accident previously evaluated in the facility's existing safety analyses? Explain your answer below.	<input type="checkbox"/> Yes <input type="checkbox"/> No
3. Could the proposed change increase the probability of a malfunction of equipment important to safety previously evaluated in the facility's existing safety analyses? Explain your answer below.	<input type="checkbox"/> Yes <input type="checkbox"/> No
4. Could the proposed change increase the consequences of a malfunction of equipment important to safety previously evaluated in the facility's existing analysis? Explain your answer below.	<input type="checkbox"/> Yes <input type="checkbox"/> No
5. Could the proposed change create the possibility of an accident of a different type than any previously evaluated in the facility's existing safety analyses? Explain your answer below.	<input type="checkbox"/> Yes <input type="checkbox"/> No
6. Could the proposed change create the possibility of a malfunction of equipment important to safety of a different type than any previously evaluated in the facility's existing safety analyses? Explain your answer below.	<input type="checkbox"/> Yes <input type="checkbox"/> No
7. Could the proposed change reduce a margin of safety? Explain your answer below.	<input type="checkbox"/> Yes <input type="checkbox"/> No

USQ Determination Summary:

If the answer to any question in Section 2, "Unreviewed Safety Question Determination" is YES, the proposed change involves an Unreviewed Safety Question. Based on the evaluation above:

This change does not involve an un-reviewed safety question.

This change requests a Categorical Exclusion and NNSA/SSO approval is required prior to implementation.

This change requests does involve an un-reviewed safety question (NNSA/SSO approval is required prior to implementation).

Complete the cover sheet summary and sign completed worksheet.
For questions regarding this form, contact [Steve Coffey](#).

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Appendix 3: Example Sandia Training Material, excerpts from course USQ100



Section Objectives

- Understand the purpose of the eUSQ program.
- Demonstrate the ability to use eUSQ in regular work activities by:
 - Reviewing and understanding the eUSQ Home Page;
 - Navigating between subsequent screens and understand how to use the special features including, copy, revise, cancel, cute editor, error messages, auto-email, PDF and attach files;
 - Completing question sets to arrive at expected result; and
 - Producing the final printed product.



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Special Features

- Uses electronic signatures.
- Auto-email to users for workflow actions.
- Safety basis documents pre-loaded for each facility in USQD worksheet.
- Ability to attach files to any USQ document.
- Copy, revise, and cancel capability for existing entries.
- DSA page change checkbox allows users to track entries that may have impact to their DSA to assist in annual update process.



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Appendix 3: Example Sandia Training Material, excerpts from course USQ100 (cont'd)



eUSQ Listing Screen

CAUTION: Do NOT put any classified, DUD or UCNI into any eUSQ screen or determination

Welcome Mary Branick

eUSQ

Your roles for this facility are: *Reviewer Preparer*

USQ Listing for ACRR

USQ(SQ) Number	Title	Status	Date Started	Preparer Name	Approved On	Select
ACRR-10000001	Test Case 021 - Only a Qualified Approver can Approve - Test Case	Entered	11/24/2010	Conness,Justin	11/25/2010	
ACRR-10000002	Copy of Test Case 021 - Only a Qualified Approver can Approve	In Approval	11/24/2010	Conness,Justin		
ACRR-10000003	Test Case 021 - Only a Qualified Approver can Approve	Entered	11/23/2010	Mar,Jeff	11/23/2010	
ACRR-10000004	Test Case 021 - Only a Qualified Approver can Approve	In Approval	11/23/2010	Mar,Jeff		

Start a New USQ Copy a USQ Review a USQ Search for a USQ

Home Page Close



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Search Screen

eUSQ

Search Criteria Screen

PREPARER	<input type="text"/>
REVIEWER	<input type="text"/>
APPROVER	<input type="text"/>
FACILITY	<input type="text"/>
TEXT IN TITLE	<input type="text"/>
TEXT IN DESCRIPTION	<input type="text"/>
USQ(SQ) NUMBER	<input type="text"/>
DATE RANGE APPROVED/REVIEWED	Start Date: <input type="text"/> End Date: <input type="text"/>
FLAGGED FOR DSA?	<input type="checkbox"/>
<input type="checkbox"/> AND <input type="checkbox"/> OR	*"AND" WILL INCLUDE ALL CRITERIA ENTERED ABOVE IN YOUR SEARCH. "OR" WILL INCLUDE ONE OF THE CRITERIA IN YOUR SEARCH.

Cancel Submit Search



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Appendix 4: Detailed Lessons Learned from Sandia

Software Documentation

Software documentation is important. The format and content for a majority of this documentation was taken from IEEE software standards. The initial documentation prepared for development of eUSQ consisted of a Requirements Document. After research to learn what had been performed on larger software projects and corporate guidance for implementing a graded approach to software quality, several other documents were added. A Software Design Document was created to sufficiently describe the eUSQ system such that another application developer with the proper skills would be able to support the maintenance and retirement phases of the software product lifecycle. A Test Plan was prepared to identify the tests necessary to verify that the requirements from the requirements documents were achieved. A software Verification and Validation (V&V) plan was created to document the level of verification and validation required for eUSQ based on application of the graded approach to software quality. A practice level and safety software determination was performed and documented to identify the magnitude of risk associated with a potential failure of the eUSQ software. A risk mitigation plan was developed to identify potential problems before they occur such that risk-handling activities could be planned and invoked as needed (e.g., how to temporarily use a paper-based system in the event of a serious software or server failure as shown in the example in Figure 1). Process diagrams were created to show how the software implements the paper-based process for creating, reviewing, and approving USQ documentation. In addition, an application screen and navigation diagram was created to document flow from a software perspective, which was useful to ensure software consistency (e.g., similar application screens had same navigation options) and enhance usability. Finally, a software lifecycle process was documented that provides information on the implementation and tools used in the software product lifecycle and version updates for the eUSQ system.

The lesson learned is that providing a level of software documentation commensurate with the level of risk associated with failure of the software will save time and effort during the software lifecycle. Collectively, these documents are expected to result in cost savings for maintaining the software and to minimize the potential for human error and software failure.

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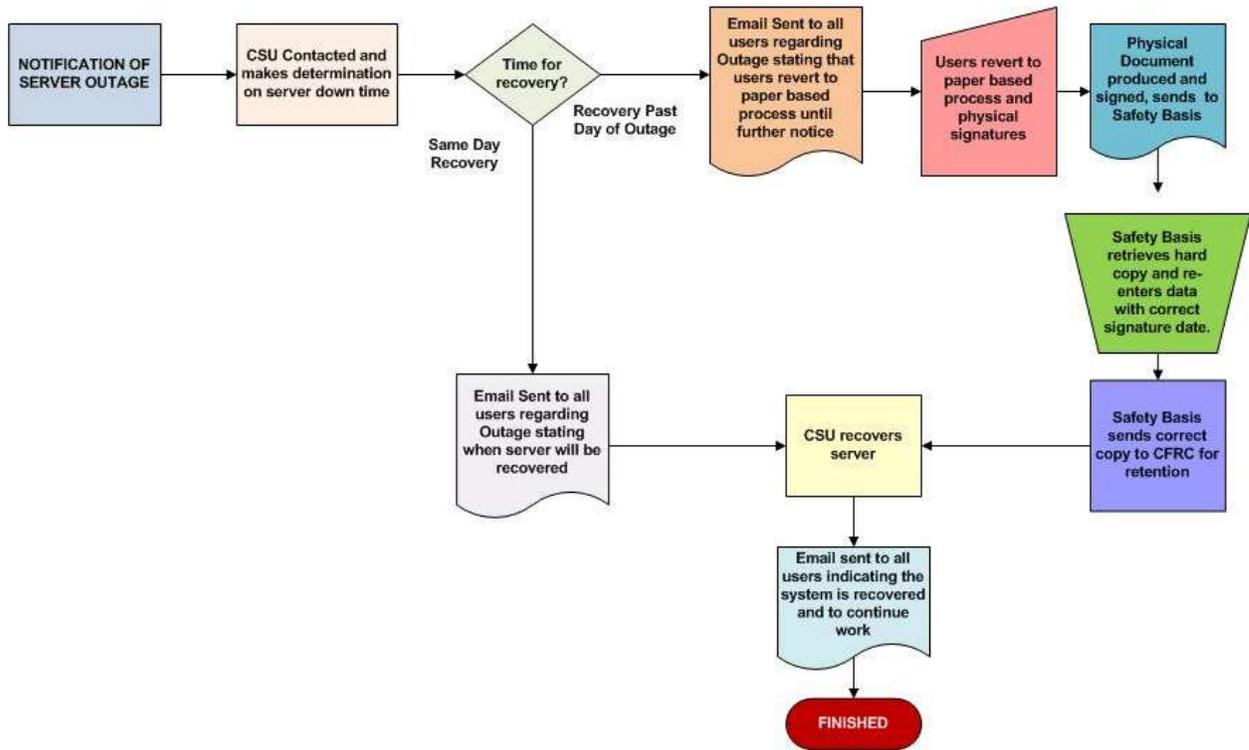


Figure 1. Example Illustrating Use Of The Paper Process In The Event Of An Extended Server Outage.

Developing an Electronic Tool

The paper-based process for performing USQ evaluations was originally believed to be very simple to translate into an electronic process, but during development was found to be much more complicated. A case-in-point was the use of two forms for the paper-based system. The first form, a screening checklist, was completed to determine the applicability of the USQD process. The second form, the USQ Determination (USQD) Worksheet, documents a detailed description, relevant information used for the evaluation, and the results of the evaluation (i.e., the answers to the seven questions). Two separate database records are generated; one for the screening checklist, one for the USQD, which are listed separately on the listing page. When performing searches, some of the search parameters entered are relevant to the screening checklist, some relevant to the USQD, and some relevant to both. When coupled with multiple Boolean conditions (AND/OR), search routines became quite complicated as information from both records need to be searched and tied together. This also resulted in an occasional listing of erroneous information (e.g., accompanying screening checklist is listed when the search was performed on a USQD approval).

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Another complication of using two forms arose based on how steps had been performed in the paper-based process. While the steps in preparing and reviewing a screening checklist and in preparing, reviewing, and approving a USQD might be perceived to only be performed in serial fashion, facility preparers would often submit the screening checklist and USQD together for review (see Figure 2). Rules had to be carefully defined for eUSQ. Should a USQD database record always be created, even if not used? And if not, what should be the point in the screening checklist process when the USQD record is created? At what point should the USQD process be halted until the screening checklist is completed?

The dynamics of the paper-based decision process had to be limited in the electronic process. For Sandia, the best solution was to create the USQD record when the screening checklist is signed by the preparer (it could be deleted afterward if the preparer alters the input to result in the conclusion that a USQD was not required), but not allow the USQD to be signed by the reviewer until the screening checklist review was completed.

Given the complexity of this approach, the next revision of the USQ procedure will likely involve one combined form. This will allow for a single database record (instead of two connected records) and one review process (instead of two intertwined review processes). This is expected to both streamline the process and the eUSQ code.

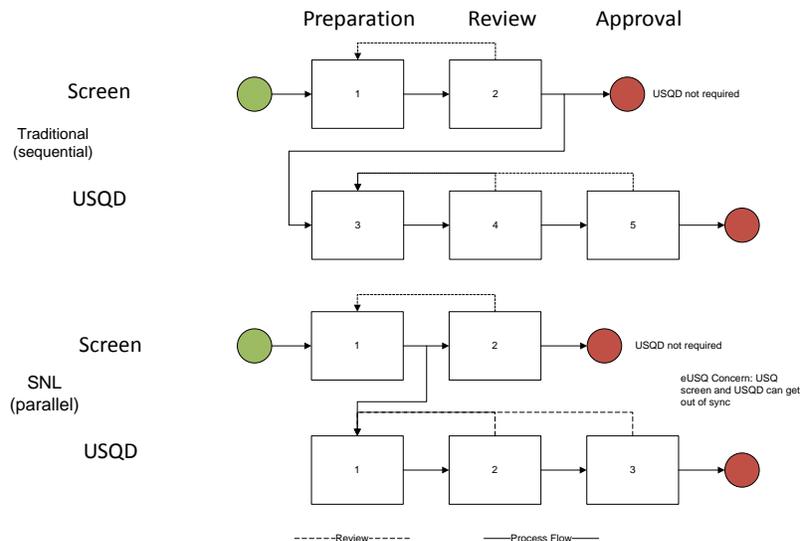


Figure 2. Traditional Versus Actual Process for Processing USQ Evaluations

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Software Platform: Web Server Application vs. PC Client Application

The eUSQ system was developed as a corporate web server application using ASPX and VB.NET code that is accessed via an internet browser. This system uses a SQL database stored on a separate server. The rich-formatted text that users input into the browser application pages is translated into HTML and stored in the SQL database.

This approach resulted in several difficulties. HTML has limitations on how text is formatted making creation of items (e.g., tables) that would be easy to create in a PC application such as Microsoft Word a more challenging task. HTML uses tags to mark formatting such as italics and bold, and when tags get nested or incorrectly ordered, the resulting text may not match the format the user desires. The two biggest problems occasionally encountered were that selecting text and formatting with the menu controls did not format the text as expected and the format of the draft PDF did not match the appearance on the computer screen (e.g., table and text would be truncated at the margin).

Another difficulty is the level of control the application developers have over the environment in which the software is running. Application developers typically have limited control over a corporate web server environment compared to stand-alone PCs. Corporate servers are designed to allow a variety of software to perform and have a higher level of security applied to server resources. An example of this impact occurred in trying to determine how to configure the eUSQ code and a PDF conversion utility running anonymously on the server such that when the utility is invoked by the code, it has access to the USQ data to create a PDF file and then have the proper access to store the PDF file in the desired location on the server. This issue became further complicated when trying to migrate the code to a new 64-bit server, as changes to the server configuration and protocols effected the way in which server processes have access to server resources.

The lesson learned for this situation would be to identify the available platforms prior to software development and attempt to estimate cost and resources for development on each platform. For eUSQ, the initial decision was primarily based on the skill sets of the application developers (as is often done). The application developers were very familiar with the programming languages used for web-based code and less familiar with code such as JAVA, that would be used for the development on a stand-alone PC client. However, many other factors should be considered including: 1) software usability (e.g., control over content such as text formatting), 2) control or lack thereof over the application environment, 3) time and resources for development and maintenance throughout the software lifecycle, and 4) ease of installation of use.

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This consideration may involve a decision regarding the level to which usability is compromised to reach a reasonable level of cost and resources, similar to a cost/benefit analysis. Since eUSQ has already been developed on a corporate server, if the above analysis were to result in a higher level of usability to convert from a corporate server application to a PC client application, the cost might not justify the gains. A better use of resources in this case might be to develop techniques to improve the user's ability to achieve their goals (e.g., use MS Word to create the table then copy/paste into eUSQ).

Ability to Access Administrative Features

The eUSQ system was originally designed to only allow the application developers the ability to modify information stored in the SQL database tables via external software such as the SQL Server Management Software. Data specific to a USQ evaluation would not be modified, however other data such as the list of qualified users and the list of safety basis documentation for each nuclear facility would require updates on an as-demanded basis. While initial development of the eUSQ system required the application developers full time, maintenance of eUSQ may not require this level of effort. Therefore the potential exists where an update to this information is required to occur when the application developers are unavailable. The solution to this potential issue was to develop an administrative module to eUSQ to allow specially-designated eUSQ administrators access to update this information. Administrators will be able to add or delete users and update their qualifications (i.e., user roles within eUSQ).

In addition to the ability to maintain this information, two report features are in development. The first is to report the number of USQDs prepared, reviewed, or approved over a specified period by user for purposes of USQ evaluator requalification. The second report is a metrics report on quantity, times, and results of USQ evaluations over a specified time.

Effect of Code Changes

As mentioned earlier, two forms are used in the Sandia USQ process; a screening checklist form and a USQD form. The screening checklist consists of three web application pages, each representing a group of questions geared toward different conclusions: 1) the changes are screened out and do not require a USQD; 2) a decision has already been made to submit the changes to DOE for approval, and 3) changes which trigger an entry condition and require a USQD. A question answered 'Yes' in either of the first two sections completes the USQ process at that point. A question answered 'Yes' in the last group of questions continues the process into the USQD.

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The software flow was originally designed to be sequential assuming that no information had been entered beyond that point. For example, when navigating from the first group of questions to the second group, the code assumed that only the first group of questions had been answered, and the act of navigating to the second group of questions results in the code evaluating the results of the screening checklist based only on the answers to the first group of questions (See Figure 3). This assumption was consistent with the directions provided on the paper form.

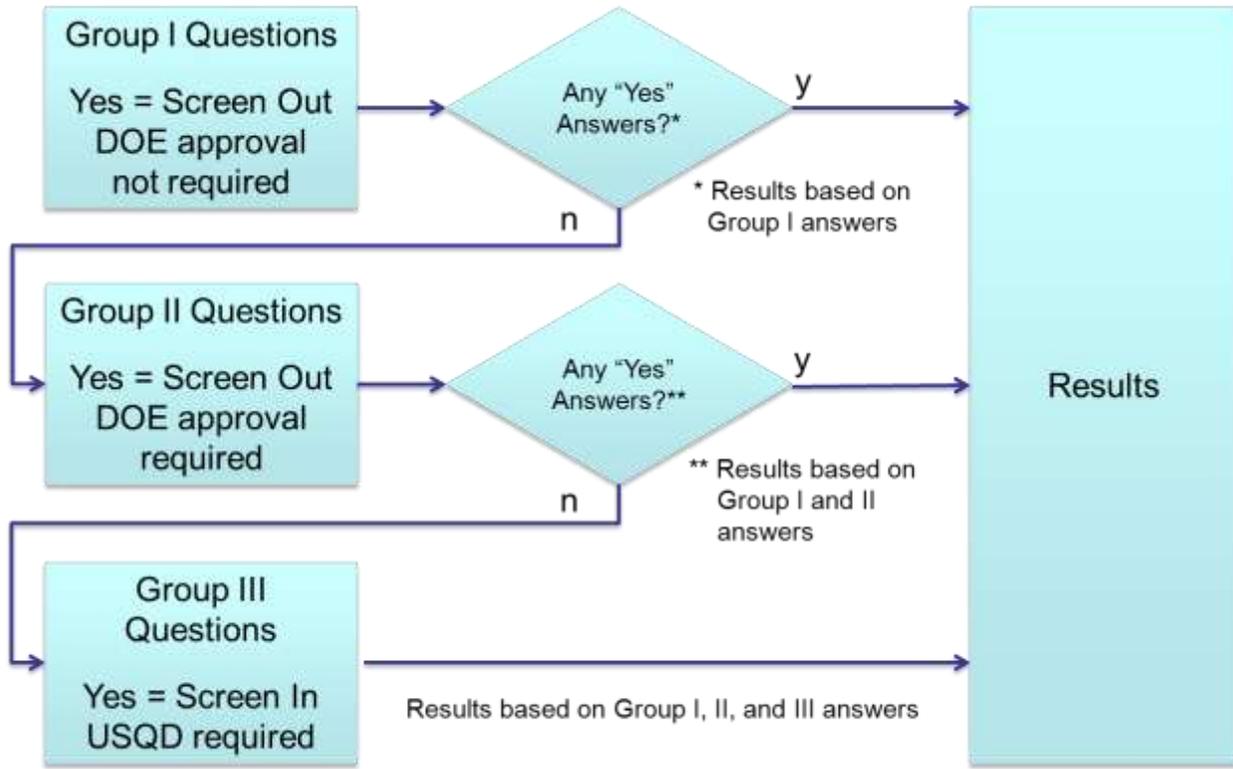


Figure 3. eUSQ Evaluation of Screening Checklist Results

At a later point, features to copy or revise a USQ evaluation were added. The eUSQ system would copy the information to the new/revised evaluation and the user would update it based on the information relevant to their new evaluation. Addition of these new features led to a requirement clarification that the draft screening checklist identifies results of the screening checklist based on the questions answered. The code was modified to provide this information using the same assumption.

An end user discovered cases where the screening checklist results on the draft PDF were not consistent with how the questions were answered. In one particular case, no information had been changed from the copied screening checklist, yet the results were different. In some cases the draft results were correct, while the

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results were incorrect for other cases. For the final screening checklist, the results were always correct.

Tests were performed, re-creating the conditions the end user provided. The problem was discovered to be that the software flow changed from what was originally assumed. When the user updates the information in the copied or revised evaluation, there already may be information in subsequent groups of questions as was the case in the above example. When the user navigated from the first group to the second group, the screening checklist results were updated ignoring a 'Yes' answer in the third group of questions.

The lesson learned is a recommendation to document software flow and assumptions that are made during development. When changes are made, the software flow and assumptions can be reviewed to determine if the changes affect the flow or assumptions. Then appropriate changes to the code can be made. This would be particularly useful if the application developer maintaining the code had no involvement in the initial development.

Software Usability

Feedback and improvement have always been encouraged for the eUSQ System to improve usability and enhance the USQ process. Four improvements worth discussion are currently in development: 1) export feature for facility or search result listing of USQ evaluations to an Excel spreadsheet; 2) batch download feature to download evaluations from a facility or search results listing, 3) provide ability to identify whether an evaluation would result in a DSA page change to support the annual safety basis update process (a data item which was not documented on the official USQ evaluation forms), and 4) provide ability to access the comment field at a later date.

The first two features are useful in creating documentation associated with the annual update of safety basis documentation and for performing assessments of the USQ process. Currently the user has to take screen snapshots or manually write down the list; with the new feature, the user will click on an Excel icon next to the listing table and the eUSQ system will prompt the user to open the spreadsheet on his/her PC, where it can then be manipulated on the user's PC. The batch download feature will save the user a significant amount of time by downloading a group of selected files to a folder on the user's PC.

Items 3 and 4 are in regard to access of information after the USQ evaluation has been completed. The initial requirements for eUSQ were to only retain PDF documentation of the completed record and to maintain the data in the database for use when copying or revising the USQ evaluation. Beyond this, little thought

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was originally provided to define additional information (that beyond the information directly used in the USQ process or required by procedure) that would be useful. Upon further discussion with the end users, the scope of the third item was broadened to include the ability to change the answer whether a DSA page change was required to support subsequent review by nuclear facility safety basis personnel for evaluations prepared by qualified operations personnel who don't have the same level of familiarity with the safety basis documents as the safety basis personnel. The lessons learned is to consider, during development, what features beyond those required by procedure that would be useful and to solicit feedback from end users on features they believe would improve productivity or usability.