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Human Error Mitigation in Future Operations Control Centers

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16. Abstract

This report documents a human error mitigation study conducted at the William J. Hughes Technical Center Research Development & Human Factors Laboratory. The study examined potential causes of human errors in future Airway Facilities (AF) operations control centers (OCCs). The participants consisted of nine specialists having expertise in current AF operations and knowledge of human error tendencies. The participants explored four operational scenarios, identified potential sources of error, and recommended specific solutions. A research team extracted common themes from participant responses to each of the four scenarios and identified general sources of potential error. They made specific recommendations for mitigating error in future OCC facilities.

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Table of Contents

Page

Acknowledgments iii

Executive Summary vii

1. Introduction 1

1.1 Background 1
1.2 Purpose 2

2. Method 2

2.1 Scenarios 3
2.2 Participants 3
2.3 Design and Procedure 4

3. Results 5

4. Conclusions 7

References 10

Acronyms 11

Appendixes

A - Scenarios
B - Scenario Errors

Executive Summary

Airway Facilities (AF) is planning and beginning to implement sweeping changes in its structure and operational concepts. These changes will provide the maintenance activities needed by the National Airspace System (NAS) of the future. At the heart of this change is the consolidation of AF monitoring and maintenance functions into fewer facilities with an increase in unmanned facilities and in remote monitoring and maintenance.

Future operations control centers (OCCs) will be challenging environments for AF personnel. Managers and specialists will be responsible for monitoring and maintaining many different types of systems, for managing people and resources across a wide geographical area, and for coordinating and sharing information with other echelons of AF as well as Air Traffic Control (ATC) personnel.

To look into the working environment of the future, the NAS Human Factors Branch (ACT-530) of the Federal Aviation Administration (FAA) William J. Hughes Technical Center conducted an error mitigation study. The purpose of this study was to identify those tasks and situations that will most likely result in errors or problems and to propose potential solutions. The ultimate goal of the study was to develop strategies to help reduce or eliminate the potential for serious operational errors in the future OCCs.

Nine participants having expertise in current AF operations and knowledge of human error tendencies took part in the study at the William J. Hughes Technical Center Research Development & Human Factors Laboratory. A research team consisting of engineering research psychologists led the participants in structured walkthroughs exploring four operational scenarios developed by AF subject matter experts. The research team asked the participants to identify tasks and situations in each scenario that could lead to errors and compiled these errors into lists. Following the scenarios, they gave each participant copies of the lists and asked them to rate each of the errors by degree of importance. The participants grouped the most important errors into categories. They then discussed potential solutions for each category and identified areas in need of additional research.

This report summarizes and documents the ideas generated from this study, identifying where and when errors will most likely occur in future OCCs and presenting suggestions for mitigating those errors. The participants identified seven major areas of concern where additional research is needed. Those areas are separation of responsibilities in the OCC, setting priorities among multiple tasks, communication and coordination at a distance, alternative methods of communication, event-ticketing procedures, data entry workload, and display of current situation and status. This research will help system architects and designers create a better, less error-prone work environment as the FAA moves toward maintenance centralization.

1. Introduction

The Federal Aviation Administration (FAA) plans to implement major changes in its structure and operations to support the future maintenance needs of the National Airspace System (NAS). Central to these changes is the consolidation of Airway Facilities (AF) management and maintenance functions into fewer, more centralized facilities combined with an increase in remotely monitored, unmanned facilities. Centrally located control centers will be responsible for monitoring and controlling these facilities, assigning personnel and resources, and coordinating AF and Air Traffic (AT) information.

1.1 Background

The consolidated operations control centers (OCCs) pose new challenges for AF personnel. AF managers and specialists in these OCCs will be responsible for managing and maintaining many different facilities across broad geographical areas. AF personnel will be required to learn new technology and procedures such as the Remote Maintenance Monitoring System (RMMS), workflow automation, and event ticketing. The new roles and responsibilities imposed by the consolidation of AF facilities and increased reliance on new technology and automation have the potential of increasing human error.

An important first step before identifying error prone tasks and situations is to introduce and define the concept of human error. Taxonomies and characterizations of error are plentiful in the literature. We have outlined some of the main points taken from literature relevant to designing systems to reduce human error. This literature study provides a basis for investigating sources or situations having the potential to cause mistakes or errors in OCCs.

1. *Errors can result when the system design exceeds the human user's capabilities.* Humans contribute to the error-generation process, but emphasis should be on the interaction between the human and other components of the system. Many complex systems place a heavy task load on the human. If the system fails to support these tasks, errors can occur. Humans must create mental models of the system and its environment to solve system problems. System demands can quickly exceed the human's mental capacity. Rasmussen (1986) noted this mismatch between system demands and human resources. Failures in perception, situational awareness, attention, decision making, memory, and information processing can cause errors. In many cases, system design problems can trigger these failures. The significance of system-induced human errors is evident from analyses of disasters such as Three Mile Island, Bhopal, and Chernobyl (Meshkati, 1991).

2. *Errors are usually the result of a chain of events.* Human errors are seldom the result of a single point of failure. Usually, they have secondary and tertiary causes as well. A simple error can become a complex error that can affect an entire system. Many complex systems have defenses against single point errors, but this type of incremental error build is more difficult to prevent. When human error occurs, there is an immediate tendency to assign fault, usually to the personnel who committed the action immediately preceding the event (proximal error). Often, there is little inquiry beyond that point, and the party responsible for the proximal error receives most or all the blame. Studies have shown that errors tend to

develop with chained and/or concurrent steps that only partly involve human performance (Pew, Miller, & Feehrer, 1981).

3. *Errors can occur due to equipment that is inadequate for the task.* Economic pressures limit both new system development and modifications. Instead of developing custom hardware or software for a particular task or function, commercial off-the-shelf (COTS) hardware and software are being adapted to various applications and environments. The use of equipment not specifically designed for the function or task may result in the need to modify operating procedures or to compromise control capability, which can increase the likelihood of error (Hill, 1989).

4. *Errors can result from the correct action if it is done at the wrong place or wrong time.* Drury (1991) categorized maintenance errors into four types: wrong place (repetition, reversal, omission), wrong time (omission, delay, premature action), wrong type (replacement), and not in current plan (insertion, intrusion). The categorization depends on the purpose of the investigation. Many systems are information-processing systems. The operator receives data, processes it, makes a decision, and then performs the actions to implement the decision. Systems often create an error environment due to untimely or insufficient data.

5. *Errors can result from a lack of organization, management, or procedures.* Reason (1990) and Woods, Johannesen, Cook, and Sarter (1994) address the roles of organization, management, and procedures. These issues have been implicated in a number of major system accidents (Meshkati, 1991). Organizational errors can also include inadequate operator selection or insufficient training as well as inadequate procedures.

1.2 Purpose

The primary purpose of this study was to examine potential causes of human error in future OCCs and identify those tasks and situations that are the most vulnerable to errors. Secondary goals for the study were to propose mitigation strategies for the errors and to identify areas in need of additional research.

2. Method

Engineering research psychologists from the FAA William J. Hughes Technical Center NAS Human Factors Branch (ACT-530) conducted the study. They walked the participants through each of four scenarios. AF subject matter experts developed and designed these scenarios to simulate events that would take place in a future OCC environment. The scenario walkthroughs took place over a 2-day period at the Technical Center Research Development & Human Factors Laboratory (RDHFL). Each scenario lasted approximately 2 hours and allowed time for discussion.

2.1 Scenarios

A summary of the four scenarios follows. For each scenario in its entirety, see Appendix A.

Scenario 1 described the loss of differential Global Positioning System (GPS) data to support Air Traffic Control (ATC). The OCC responsible for the Dallas-Fort Worth Airport receives a warning that the GPS signal will be lost due to weather interference. The OCC plans a transition to ground-based backup systems. In preparing for the transition, the OCC learns that one of the essential ground facilities is having routine battery maintenance performed on its power backup. The OCC contacts the specialist assigned to the battery maintenance task and requests top priority for backup power restoration. Backup power is restored, and the transition to ground-based systems proceeds smoothly.

Scenario 2 involved multiple, overlapping events including en route radar failure, reported radio interference, and radio communications link failure. The scenario began with an en route radar failure at the Keller site. A few minutes later, ATC reports radio interference on the air/ground radio. Almost immediately, there is a loss of a radio communications link at the Las Cruces site. The specialist at the OCC must locate and dispatch specialists to the Keller and Las Cruces sites and report the frequency interference problem to frequency management.

Scenario 3 involved a hazardous materials (HAZMAT) spill that impedes radar repair. The scenario includes a concurrent heating and ventilation system failure and an intrusion alarm at an unmanned beacon site. The OCC contacts the regional HAZMAT office, which subsequently dispatches a team to clean up the spill. After the clean up, the field specialist replaces the transformer.

Scenario 4 began with an Airport Surveillance Radar (ASR)/MODE-S failure at San Antonio Airport. Inclement weather then causes an equipment failure at the Keller Air Route Surveillance Radar (ARSR) site. In addition, the OCC is coordinating with the Flight Check Control Center to schedule a flight check of the instrument landing system at the Dallas/Fort Worth Airport. The flight check aircraft then arrives earlier than expected. The OCC specialist remotely resets Channel A of the Keller ARSR site. The field specialist finds and resets a circuit breaker that has caused the San Antonio MODE-S to fail. Later, the OCC specialist reviews the history of related problems and discovers that the same circuit breaker has failed repeatedly. The specialist then contacts engineering support to discuss a modification kit for all breakers of this type.

2.2 Participants

Nine experts consisting of six AF specialists, one AT specialist, and two engineering research psychologists discussed potential sources of error relative to the four scenarios. Three of the AF specialists worked at a prototype OCC. Of those three, one worked with the event-ticketing prototype, one helped to define OCC roles, and one assisted with workforce management. The other three AF participants were from Air Route Traffic Control Centers (ARTCCs) or General Maintenance Control Centers. Geographically, the group represented New England, the Southern Region, the Eastern Region, the Central Region, and the Western Pacific Region.

2.3 Design and Procedure

Before the introduction of the scenarios, the research team presented a background briefing to the participants. They first discussed project goals and the human factors approach to error investigation. A member of the research team discussed alternative views of human error and pointed out implications of human error such as physical injury, damage to equipment, inefficiencies, unnecessary cost, and wasted resources. He instructed that human errors leading to any of these results were of interest to the study. The briefing included an examination of psychological sources of error including attention, situation awareness, decision making, estimation, computation, and memory problems.

The research team then addressed the future AF concept of operations (FAA, 1995) in which the FAA plans to have a single National OCC (NOCC), several OCCs, and many work centers. The researcher discussed the implications of this hierarchical concept with respect to management and information needs. The FAA plan calls for more centralized management of people and resources and depends on an information highway, the RMMS, greater AT coordination, and greater use of mobile specialists. This plan will incorporate the capability to identify and track tasks through a system called event ticketing. The researcher described some of the other technology that would be utilized in future OCCs. The RDHFL technical support staff then showed a virtual reality presentation of what a future OCC facility could look like.

A member of the research team concluded the briefing by explaining the method that the participants should use while stepping through a sample scenario. He advised that the participants would be identifying potential error situations and proposing possible strategies for preventing or mitigating errors, which could involve operational procedures, system design, training, or staffing. The research team presented the scenarios following the briefing.

The researchers used the same procedure for all of the scenarios. The participants completed Scenario 1 and 2 on Day 1 and Scenarios 3 and 4 on Day 2. Copies of the scenarios were given to each of the participants so that they could follow the text as they "walked through" each scenario. Two of the scenario developers were available to answer any questions during the walkthroughs.

A researcher initiated the discussion for each scenario by reading a few lines and then pausing and asking if the participants foresaw a cause for concern or failure. A second researcher captured the participants' comments on slides for each scenario and projected them for all members to see. At the end of each scenario, the participants rated the errors on a 3-point scale, with 1 indicating low importance and 3 indicating high importance. Importance was defined as being highly likely to occur or having a major operational impact, or both. A researcher tallied the results and placed the potential sources of error that more than half of the participants rated highly important on slides. Following the scenarios, the research team asked the participants to sort these errors into major categories. As the participants made suggestions, a researcher rearranged the slides into groups with a label identifying the problem area. The study concluded with the participants developing mitigation strategies for each of these major problem areas and identifying areas in need of future research.

3. Results

Appendix B contains a list of errors (including those rated as low importance) that the participants identified for each individual scenario. They grouped the errors identified as most important into the following 13 categories.

Two-way Communication and Active Coordination Errors. Potential coordination errors involve failure to acknowledge information, confusion over whether messages have been received, and concern that critical information might not be communicated. The participants discussed communication and coordination errors that might occur between the Satellite Center and the OCC, the specialist in the field and the OCC, and ATC and the OCC.

The participants felt that the weakest communication link in the scenarios would be between the OCC specialist and remote field specialists (e.g., cellular telephones have dead spots in the mountains of Tennessee). The participants noted that instant communication might be less necessary in the future due to close coordination with ATC.

Solution: The participants suggested preventing two-way communication and active coordination errors by using different communication modes for different message priorities. They suggested using e-mail for routine administrative communication and using the e-mail receipt function when information required an audit trail, reserving voice communications for time critical information. The participants felt that event tickets could replace some types of communication. However, they saw a need for information filtering. The participants felt that event tickets could page a specialist and send "broadcast" e-mail.

Current Status Information. The participants thought that everyone in the OCC must know about certain critical events such as GPS signal degradation and transitioning to ground-based backup systems. Otherwise, OCC specialists might make poor decisions leading to degraded service.

Solution: The participants suggested using a large-screen, communal status board and a coordinating specialist to identify critical information for posting.

Critical Facility Identification. The participants noted the difficulty of tracking the role each facility plays in providing a level of service under different operating conditions. Errors could result if OCC personnel took a facility off line, and it was suddenly required for backup purposes.

Solution: The participants suggested convening a committee to decide which equipment is critical for different types of services and embodying this in a checklist or decision aid. The participants felt that the OCC must have tools showing what facility an ARSR feeds and what Center Radar Approach facility might be affected by the ARSR. The participants considered AT presence essential in the OCC for this type of coordination.

Event Ticketing. The participants saw the possibility of increased errors if event tickets were not opened and closed in a timely manner by responsible personnel.

Solution: The participants suggested making event ticket entries as easy as possible by providing data entry tools for data entry. Autopopulation of event tickets should be used when possible to minimize data entry errors. Procedures should be created to ensure that errors do not occur due to confusion over who is responsible for resolving and closing an event ticket.

Jurisdiction. These problems involved errors occurring because the OCC, the work center, and the specialists were unclear as to who was responsible for fixing a problem.

Solution: The participants believed that standard operating procedures could prevent problems of this type.

Lack of Information for the Job. The participants expressed concern that the RMM system would not provide enough information for remote certification or maintenance actions. They were concerned that OCC specialists might try to perform remote maintenance functions on facilities for which they were not receiving live data, without receiving adequate feedback to do the job. For example, a specialist would have difficulty trying to adjust a radar remotely without being able to see the resulting radar "picture".

Solution: Design equipment to provide adequate information and immediate feedback for remote maintenance actions.

Breadth versus Depth of Knowledge and Experience. These errors could occur if the OCC specialists do not have the necessary breadth of experience to establish maintenance priorities or to maximize resources. Specialists may fail to see the relationships necessary to solve problems that have a common cause.

Solution: The participants recommended careful screening of personnel for the OCC specialist positions and providing new kinds of training including specific training in communication skills and managing multiple tasks. The specialist needs breadth of knowledge and interpretation skills yet must be familiar enough with the field training to be able to communicate with the field technicians. Participants also pointed out the need to do a thorough task analysis of OCC functions.

Distributed Communication Errors. This category addressed errors resulting from misunderstandings among individuals separated by distance, particularly between individuals with different backgrounds and training. The participants were especially concerned with the possibility of miscommunication between AT and AF due to differences in terminology and context.

Solution: The participants felt that maintaining an AT presence in the OCC would be a big step toward minimizing these types of errors. They also felt that it would be useful to standardize vocabulary where possible.

HAZMAT Training Errors. The participants speculated that the OCC or field specialists would not recognize the presence of HAZMATs.

Solution: The participants recommended that specialists be thoroughly trained about HAZMAT situations to ensure proper reporting and handling.

Database Errors. This category dealt with having incomplete, out-of-date personnel and resource information in the database.

Solution: The participants recommended having an organizational infrastructure responsible for entering and ensuring accuracy of the data. To facilitate this goal, the participants stressed the need for data entry tools to facilitate keeping the database current.

Morale-Related Errors. The participants speculated that work center specialists might have lower morale because they will have broader responsibilities, possibly causing them to lose the sense of ownership and pride associated with responsibility for a single piece of equipment.

Solution: The participants thought specialists should be given more recognition for their expertise and suggested using non-monetary rewards to improve morale. Overall, the participants speculated that higher morale would result in lower errors.

Workload Errors. The participants were concerned that the additional workload caused by excessive data entry requirements in the OCC could result in operational errors.

Solution: The participants suggested streamlining reporting requirements and making efficient use of event tickets to eliminate redundant reporting. They felt that, with the right tools and the right training, there would not be a need to make a choice between doing the technical work and writing the report.

Manpower and Staffing Errors. The participants were concerned that an OCC would not have the necessary staff if crises and errors occurred.

Solution: The participants suggested providing the OCCs with the authority to transfer staff during emergencies. The OCC architecture needs to be robust to handle natural disasters or war-like situations. A common database and common procedures would make it possible for one OCC to take over responsibilities for another in case of an emergency.

4. Conclusions

The participants felt that there were many positive aspects of the OCC concept. They felt that the movement toward automated logging systems and other technology were positive trends and 24-hour monitoring was a good concept. There were several areas that the participants identified as requiring further investigation to help clarify and resolve issues for OCC operation, as follows.

Separation of responsibilities in the OCC. An essential concern mentioned repeatedly by the participants was the organization and assignment of responsibilities within the OCC. The consequences resulting from the assigning responsibilities is an important area for future research.

Setting priorities among multiple tasks. A major source of potential errors identified by the participants was the difficulty of correctly setting priorities among tasks that compete for limited time and resources. Decision aids could potentially help to minimize this problem, allowing specialists to evaluate a planned action in light of its possible consequences. They felt further research was needed to identify the information required to set priorities and to develop and test effective decision aids for that information.

Communication and coordination at a distance. Communication difficulties were often cited as possible precursors to errors, with several different types of communication problems mentioned. Terminology differences between AT and AF were identified as a possible source of errors. Communication at a distance can exacerbate these problems. Communication issues like these could be investigated through human-in-the-loop scenarios.

Alternative methods of communication. Communication between the OCC and individuals at other locations could take many forms such as voice, fax, or e-mail. Based on the number of voice communications in current facilities, voice communications in the future OCCs have the potential of reaching unmanageable proportions. Future research should investigate how to effectively use alternatives to voice communication. This research should also examine ways to provide acknowledgement for individuals requesting OCC services through alternate means of communication.

Event-Ticketing Procedures. The participants raised a number of concerns about event-ticketing procedures. They wanted to know how event tickets would be opened, assigned, kept up to date, and closed. Confusion over who is responsible for a particular event ticket could easily lead to errors. Research should be done to test event-ticketing procedures. Research into this area could identify problems, confusions, and misunderstandings associated with the event-ticketing procedures, and mitigation strategies could be identified.

Data entry workload. The OCC concept relies heavily on the existence and availability of up-to-date databases and event tickets. Several of the potential errors identified in this study are caused by outdated databases. The data entry needed to keep these databases and event tickets current has the potential of being very time consuming and labor intensive. Further research is needed to determine the workload associated with data entry and to identify ways in which this workload could be reduced. Alternative methods of data entry such as a card reading system or speech recognition systems should be investigated. Methods of database autopopulation taking advantage of current technology such as caller ID should also be investigated.

Display of current situation and status. A number of concerns raised by the participants involved the need for shared information on the status of the current situation. Without shared information, specialists within the OCC might make decisions or act without understanding the consequences of those actions for other activities within the OCC. Further research should look into how to display critical information to optimize situational awareness.

As described previously, the literature has identified several potential sources of error. The OCC-specific potential sources of error described by the participants in this error mitigation study reflected many of these ideas. This report also describes possible mitigation strategies for

these errors, including the need for additional research in some areas. This work will allow the future OCCs to be proactive in avoiding operational errors and potentially avoiding physical injury, damage to equipment, inefficiencies, unnecessary cost, and wasted resources.

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Acronyms

AF	Airway Facilities
ARSR	Air Route Surveillance Radar
ARTCC	Air Route Traffic Control Center
ASR	Airport Surveillance Radar
AT	Air Traffic
ATC	Air Traffic Control
COTS	Commercial-Off-the-Shelf
FAA	Federal Aviation Administration
GPS	Global Positioning System
HAZMAT	Hazardous Materials
NAS	National Airspace System
NOCC	National Operations Control Center
NOTAM	Notice to Airmen
OCC	Operations Control Center
RDHFL	Research Development and Human Factors Laboratory
RMMS	Remote Maintenance Monitoring System

Appendix A
Scenarios

Scenario 1 - GPS Outage Due to Inclement Weather

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
10:30	**Inclement weather** Dallas-Fort Worth operating under the Differential GPS. Bad weather advisory for Dallas-Fort Worth for next 12-16 hours **Alert issued** Satellite center issues advisory alert: --increased weather disturbances --signal may be degraded --system may be out for 16 hours.	**Alert received** Receive and be aware of alerts. **Remote investigation** Monitor quality of Signal. **Remote investigation** Determine local traffic impacts on ground system. **Report produced** Produce reports: --satellite signal has decreased but not to unsafe levels --all parameters within tolerance. **Event ticket opened** Open event ticket and describe situation.	Weather service advisory warning Degraded signal alert on National Infrastructure Management information highway RMM screens (monitor quality of signal) ATC Flow Control screens RMM screens (display of system health parameters) Event ticket screens
10:35	**Alert updated** Satellite center sends second message that full degradation is expected by 12:00. **National Flow Control involved** National Flow Control determines impact of outage on air traffic flow. **ATC involved** ATC plans rerouting.	**Phone conference initiated** OCC coordinates with NOCC and Flow Control to recommend switch to ground-based system. **Remote adjustment** Adjust services and facilities affected by the rerouting (ILS, VORTAC, Non-Directional Beacon, etc.). **Remote certification** Certify these facilities	Telephone (3-way communication) Flow Control screens (simulated traffic flow) Remote Maintenance Monitoring screens (change equipment parameters remotely if necessary) Certification screens

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
10:40		**Remote investigation** Determine ground-based system is operational except for power backup.	Facility status screens
		Remote investigation Learn that backup power system released for routine battery maintenance.	Event ticket screens (status file on backup power)
		Specialist contacted Contact specialist by multiple means; give direction that backup power restoration is top priority; wait for acknowledgment of message.	E-mail, telephone (automated dialing), pager, 2-way radio
		Event ticket updated Enter contact and prioritization information into event ticket.	Event ticket screens (case file)
		Daily journal activity log updated Update daily journal activity log.	Daily journal activity log
	Repair begun Specialist working on backup power system.		
10:45	**Repair completed** Specialist returns backup power to normal.		Event ticket screens
	Event ticket updated Specialist updates event ticket to show repair completed.		Facility certification screens
		ATC informed of status OCC informs ATC that all facilities/services are certified for transition to ground-based system.	Facility status screens (status board)
		Phone conference initiated Coordinate with ATC and Flow Control concerning traffic management.	Telephone (3-way) Flow control screens

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
10:53		**ATC informed of status** Notify ATC that ready for transfer to ground-based control.	Telephone
		Event ticket updated Update event ticket.	Event ticket screens
		NOTAM requested OCC requests NOTAM that GPS is going out of service.	Telephone
		Event ticket updated Enter coordination in event ticket.	Event ticket screens
		Remote Certification Update certification file on GPS. Include notice that GPS is being removed from service.	Facility certification screens
	Notice to Airman (NOTAM) issued ATC transmits NOTAM announcing switch to ground based systems (ILS, VORTAC, and Non-Directional Beacon approach procedures).		Datalink
11:00	**National Flow Control involved** National Flow Control prepares to switch air traffic to ground based systems. **ATC involved** Dallas-Fort Worth traffic flow impact is managed.	**Remote monitoring** Monitor performance of GPS locations for signs of deterioration.	RMM screens (performance parameters display)
11:30		**Acknowledgment sought** OCC reviews event ticket to ensure that all users are aware that transfer of system is imminent.	Event ticket screens (coordination logs) e-mail “return receipt” messages

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
11:45	**Announcement made** NOCC announces that transition will take place at 1200 hours. **National Flow Control involved** National Flow Control adjusts traffic flow and reroutes traffic in preparation for 12-noon transition. **Announcement received** Aircraft receive message via datalink **Announcement received** Airlines receive message	**Announcement received** OCC receives announcement regarding transition.	NIMS information highway Flow Control screens Datalink E-mail
11:55	**ATC involved** ATC transfers all users to the ground-based system	**Remote monitoring** Check status display --everything ready for transfer. **Control verified** Verify OCC has control of ground-based systems. **Remote monitoring** Verify all ground-based systems are available for transfer. **Remote adjustment** OCC brings ground-based systems to operational status. **Specialist contacted** Contact specialist to alert that ground-based systems are now operational. **Event Ticket updated** Update case log **Specialist contacted** Ask specialist to evaluate satellite ground station	Facility status screens (DME, glide slope, inner and outer markers, lights, localizer, etc.) RMM screens (remote control of ground-based system) RMM screens RMM screens (remote control of ground-based system) Telephone (autodialing), event ticket screens RMM screens (system health parameters) Event ticket screens Telephone
12:00	**Transition made** Transition to ground-based system complete	**Specialist contacted** Inform Specialist that WAAS station released for evaluation	Telephone (autodialing)

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
12:01	**Examination begun** Work center takes WAAS station off-line. **ATC involved** Dallas-Fort Worth ATC adjusts flow and reroutes traffic as required.	**Transition confirmed** Observe WAAS off-line. **Monitoring** Observe flow control change.	Facility status screens Flow control screens
13:15	**Examination completed** Work center completes evaluation of WAAS.	**Examination results acknowledged** Observe that WAAS ground station is available for use. **Monitoring** Access performance of WAAS, check parameter values, and validate ready for use. **Event ticket updated** Keep event ticket open until return to WAAS. **Workforce history updated** OCC updates records to show specialist has left site.	Facility status screens RMM screens (system parameter display) Event ticket Workforce management screens

Scenario 2 - ARSR/En Route Radar Failure

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
21:00	**Equipment failure** Keller ARSR fails: ATC observes loss of radar and beacon data on displays.	**Monitoring** OCC monitoring facilities.	Facility monitoring screen
		Alarms OCC receives alarm indicating loss of radar data (en route) and beacon data (en route) services.	Facility monitoring screen
		Alarm acknowledged OCC acknowledges alarm.	Facility monitoring screen
		Phone call received OCC receives call from ATC.	Telephone
		Event ticket opened OCC initiates event ticket.	Event ticket screens
21:02		**Remote adjustment fails** OCC attempts to reset ARSR. Reset attempt is unsuccessful.	Facility RMM screen Facility status screen
21:03		**Remote adjustment** OCC reconfigures sort box(s) priority to enable alternate radar and beacon data on displays.	Facility RMM screen (ARTCC host computer)
21:04	**Radio interference** ATC reports interference on 139.85 departure at Red Bird Remote Center Air/Ground Radio Communication Facility, auditory signal degraded.	**Remote investigation** OCC opens event ticket and remotely investigates source of interference.	Event ticket screens (frequency interference report)
21:05	**Communication failure** Loss of Radio Communication Link data from Las Cruces Radio Communication Link (Microwave Repeater) site. Loss of data from Deming ARSR-4. Loss of communications to/from Deming Remote Center Air/Ground Radio Communication Facility. Loss of communications line to Columbus VORTAC.	**Alarms** Alarms at OCC. Las Cruces Radio Communication Link data failure alarms and Data Multiplexing Network alarms. Loss of Deming Radar Data (en route service), Beacon Data (en route service) and En Route Communication services. Loss of communication link to Columbus VORTAC (unable to monitor VORTAC).	Facility status screens
		Event ticket opened OCC initiates event ticket	Event ticket screens

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
21:06		**Remote investigation** OCC acknowledges alarms, and immediately determines multiple failures are a result of a Data Multiplexing Network failure (Las Cruces Radio Communication Link).	Facility status screens
21:07	**ATC involved** ATC observes loss of radar and beacon data from Deming sector. Loss of communication to Deming Remote Center Air/Ground Radio Communication Facility.	**Phone call received** ATC notifies OCC of loss of data from Deming Facilities, and advises OCC that radar data (en route Service), beacon data (en route Service), and en route communication services are lost. **Remote Investigation** OCC reviews site information.	Telephone Facility status screens
21:08		**Remote adjustment** OCC performs reconfiguration of lost data and reconfigures system.	Facility RMM screens
21:09	**Restoration of service confirmed** ATC confirms restoration of radar, beacon and communication services.	**Remote adjustment** OCC restores data via alternate path. **Event ticket updated** OCC updates event ticket.	RMM screens Event ticket screens
21:10	**Specialist en route to site** Specialist responds, departs for the Radio Communication Link (microwave repeater) site in Las Cruces.	**Specialist contacted** OCC locates specialist, notifies him of work around, and tells him to respond to the Las Cruces Radio Communication Link failure.	Workforce management screens Autodialing (telephone)
21:11	**NOCC involved** NOCC acknowledges event ticket regarding failure of Keller ARSR.	**Remote investigation** OCC performs fault isolation/diagnostics on Keller ARSR facility.	Facility RMM screens (ARSR, Data Multiplexing Network)
21:12		**Remote investigation** OCC determines problem is at ARSR site. **Event ticket updated** OCC updates event ticket.	Facility RMM screen Event ticket screen
21:13		**Specialist selected** OCC determines specialist availability.	Workforce management screen

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
21:14	**Specialist reached at home** Specialist not on site, site is currently unmanned, specialist contacted at home and instructed to respond to ARSR failure.	**Specialist contacted** OCC performs callout procedures for facility restoration.	Workforce management screen, telephone, pager, e-mail
21:20	**Specialist enroute** Specialist departs residence for ARSR site.		
21:21		**Remote investigation** OCC specialist determines interference at Red Bird Radio Communication facility is on both main and standby channels.	Facility status monitoring screens Facility RMM screens
21:22		**Authorities notified** OCC specialist contacts Frequency Management and reports interference at Red Bird Remote Center Air/Ground Radio Communication Facility. Refers Frequency Management to frequency interference report	Autodialing (telephone) Event ticket screens (frequency interference report)
21:45	**Specialist arrives at site** Specialist arrives at Keller ARSR site and updates event ticket; assumes control of facility.	**Specialist's arrival acknowledged** OCC acknowledges specialist is at Keller ARSR site. **Control transferred** Releases control to onsite specialist.	Event ticket screen Facility RMM screen
22:00	**Specialist arrives at site** Specialist arrives at the Radio Communication Link (microwave repeater) site in Las Cruces, notifies.	**Specialist's arrival acknowledged** OCC acknowledges site specialist in Las Cruces.	Event ticket screens
22:30	**Diagnosis** Specialist informs OCC of Radio Communication Link antenna failure. **Parts ordered** Antenna dish placed on order, replacement dish will arrive in 24 hours.		Event ticket screens Logistics information system screens
22:40	**Specialist departs site** Specialist departs site.	**Decision** OCC will remain in reconfigured operation until antenna dish can be replaced.	Event ticket screens

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
22:45	**Specialist arrives at site** Specialist arrives at Keller ARSR site. **Diagnosis** Specialist discovers failed component in antenna control cabinet. **Parts available** Specialist determines that spare is available onsite. **OCC informed of status** Informs OCC replacement of failed component will require at least 1 hour. **Repair begun** Specialist begins repair.	**Specialist acknowledged** OCC responds to work center Specialist's arrival at Keller ARSR site. **ATC informed of status** OCC informs ATC of estimated time to restore.	E-mail/telephone Local facility test equipment Logistics Information screen Telephone
23:00	**Diagnosis** Frequency Management tracks down and reports that spurious transmission at Red Bird is being emitted from a local FM radio station.		Regional frequency van
23:01	**Event ticket updated** Frequency Management updates event ticket screens.	**Diagnosis received** OCC receives notification that interference at Red Bird is being emitted by a local FM radio station.	Event ticket screens, telephone, e-mail
23:02	**Authorities discuss problem** Frequency Management and local Federal Communications Commission discuss exact cause of interference.	**Authorities notified** OCC informs local Federal Communications Commission office of radio station interference. **Phone conference initiated** Conferences Frequency Management and local Federal Communications Commission office.	Telephone
23:12	**Authorities take action** Local Federal Communications Commission takes action with radio station to resolve interference. **Event ticket closed** Frequency Management closes event ticket.		Event ticket screens

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
23:20		**Resolution** OCC informs ATC frequency interference is resolved Returns frequency to service. **Remote Certification** OCC certifies services.	Telephone Facility certification screens
23:45	**Repair completed** At Keller ARSR site, replacement of failed antenna component completed. **Event ticket updated** Event ticket updated Onsite specialist updates event ticket. **Certification** Specialist locally certifies ARSR and updates event ticket.	**Repair acknowledged** OCC Specialist acknowledges event ticket update.	Event ticket screens Facility certification screens
23:46	**Control transferred** Specialist releases control of ARSR site to OCC.	**Control accepted** OCC assumes control of Keller ARSR site. **Remote adjustment** OCC reconfigures sort-box(s) to re-establish Keller ARSR priority.	Facility maintenance screens (Keller ARSR) Facility maintenance screens (ARTCC host computer)
23:47	**Repair confirmed** ATC acknowledges ARSR /beacon return to service.	**Remote certification** OCC specialist performs system level certification of ARSR and beacon service and returns ARSR /beacon to service.	Facility status screens Facility certification screens
23:48	**Specialist departs site** Onsite specialist departs site.	**Specialist dismissed** OCC specialist informs site specialist that service is restored and certified, specialist can return to residence. **Event ticket closed** OCC specialist closes event ticket. **Workforce Management screens updated** OCC updates records to show Specialist has left site.	Event ticket screens Facility status screens Event ticket screens Workforce management screen
23:49	**Repair acknowledged** NOCC acknowledges closure of event ticket.		Event ticket screens

Scenario 3 - HAZMAT Spill

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
08:00		**Remote monitoring** Southwest Region OCC monitoring the National Radio Communications System within its area of control.	Facility status screens
08:10	**Equipment failure** Texarkana ARSR Channel A fails; automatic switch to Channel B.		Texarkana ARSR Channel A in alert status
08:11		**Alert acknowledged** OCC acknowledges alert. **Remote adjustment** OCC unable to restore channel A. Texarkana operating on Channel B. **Event ticket opened** Event ticket initiated.	Facility maintenance screens (indicate loss of high-voltage Channel A) Facility maintenance screens Event ticket screens
08:13	**Equipment failure** Heat/ventilation/air conditioning system at Houston ARTCC day care center fails.	**Phone call received** OCC receives call that heat/ventilation/air conditioning system at day care has failed. **Event ticket opened** OCC opens event ticket.	Telephone Event ticket screens
08:15		**Specialist selected** OCC picks work center specialist to call regarding failure in Texarkana ARSR.	Workforce management screens
08:16		**Specialist contacted** OCC notifies work center specialist to respond.	E-mail, telephone, pager, etc.
08:20		**Specialist's arrival awaited** OCC waiting for work center specialist to respond at Texarkana site.	
08:21		**Specialist selected** OCC assigns ARTCC environmental systems specialist to deal with heat/ventilation/air conditioning system at day care center.	Workforce management screens
08:22	**Specialist responds** Environmental systems specialist receives notice regarding failed heat/ventilation/air conditioning system.	**Specialist contacted** OCC notifies environmental specialist and work center via e-mail.	E-mail/NIMS information highway E-mail

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
08:50	**Specialist departs for site** Environmental systems specialist goes to day care site. **Repair begun and completed** Specialist repairs heat/ ventilation/air conditioning system.		Event ticket screens
09:00	**Specialist arrives at site** Specialist arrives at Texarkana ARSR; access event ticket via NIMS information highway.	**Specialist's arrival noted** OCC observes that event ticket is acknowledged by specialist at Texarkana site.	Event ticket screens
09:15	**HAZMAT** Specialist at Texarkana observes Pulse Forming Transformer has overheated and has ruptured. Transformer oil is leaking and spilling onto floor. Transformer oil contains PCB. **Announcement made** Specialist contacts OCC by telephone; declares HAZMAT incident.	**Announcement received/ alert issued** OCC acknowledges HAZMAT condition at Texarkana resulting in an "alert" condition, requiring immediate attention.	Telephone, e-mail
09:16	**Intrusion alarm** Unauthorized access at Anson ATCBI-5.	**Alarm** Intrusion alarm occurs at Anson ATCBI-5 beacon only site.	Facility status screens
09:17		**Alarm acknowledged** OCC acknowledges alarm. **Event ticket opened** Opens event ticket.	Facility status screens Event ticket screens
09:18		**Phone call made** OCC calls Anson ATCBI-5 to verify presence of authorized personnel—No Answer.	Telephone

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
09:19		**Authorities notified** OCC identifies and contacts HAZMAT regional officers regarding transformer oil spill at Texarkana ARSR.	Workforce management screens, telephone
	NOCC involved/ Alert acknowledged NOCC observes alert condition at Texarkana NOCC acknowledges alert.		Telephone, e-mail
	Parts available Specialist confirms availability of replacement transformer.		Logistics information system screens
	Event ticket updated Specialist updates event ticket regarding availability of parts.		Event ticket screens
09:20		**Authorities notified** OCC contacts regional HAZMAT and Safety Officers regarding oil spill.	Workforce management screens, telephone, e-mail
		Specialist contacted OCC makes decision to have specialist abandon and secure Texarkana site; informs specialist.	Telephone
		Recommendation made Recommends to Regional HAZMAT and Safety Officers that HAZMAT response team be dispatched to Texarkana.	Event ticket screens
	NOCC involved/ Recommendation acknowledged Texarkana site specialist, regional HAZMAT and Safety Officers, and NOCC acknowledge OCC.	**Event ticket updated** Update event ticket with latest acknowledgments and decisions.	Telephone Event ticket screens
09:25		**Medical referral made** OCC coordinates and provides for a medical evaluation for work center specialist that was exposed to PCBs.	Telephone
		Union representative contacted OCC informs Bargaining Unit representative of HAZMAT incident.	Telephone

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
09:30	**Decision acknowledged** ATC, NOCC concur and acknowledge OCC.	**Decision** OCC makes decision to continue operating Texarkana single channel, and defer restoration of redundant channel until HAZMAT response team can clean up site; site will remain on single channel until site is restored. **Event ticket updated** Update event ticket with latest acknowledgments and decisions.	Event ticket screens
09:35	**Specialist arrives at site/Troubleshooting begun** Abilene specialist continues to work intrusion alarm issue.	**Specialist contacted** OCC specialist contacts Abilene work center and informs them of intrusion alarm at Anson ATCBI-5.	Telephone
10:30	**Repair completed** Abilene specialist resolves issue (faulty microswitch on facility door). **Event ticket updated and closed** Specialist closes event ticket.	**Event ticket entry acknowledged** OCC acknowledges closed event ticket.	Event ticket screens
11:00	**Event ticket updated** Environmental systems specialist completes event ticket resolution for day care center heat/ventilation/air-conditioning failure.	**Event ticket entry acknowledged** OCC acknowledges event ticket for day care center; heat/ventilation/air conditioning failure.	Event ticket screens
11:01		**Event ticket closed** OCC closes event ticket	Event ticket screens
14:30	**Team arrives at site** HAZMAT team arrives at Texarkana oil spill site and updates event ticket.	**Team's arrival acknowledged** OCC acknowledges event ticket showing team's arrival at site.	Event ticket screens

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
15:00	**Recommendation made** HAZMAT team advises that all power will have to be removed from ARSR equipment in order to facilitate clean-up; requests ARSR be removed from service for 24 hours. **Event ticket updated** HAZMAT team updates event ticket to show request to OCC to remove ARSR from service for 24 hours.	**Recommendation acknowledged** OCC acknowledges HAZMAT teams request for removal of ARSR service and estimated time to restore of 24 hours.	Telephone Event ticket screens
15:01	**Decision awaited** HAZMAT team "on hold" awaiting decision from OCC on service removal request.	**Telephone conference initiated** Telephone Conference initiated OCC immediately conferences with ATC and Flow Control, to advise and reach an agreed time for removal of service for Texarkana ARSR.	Telephone (3-way)
15:05	**Decision acknowledged** NOCC and HAZMAT team acknowledges OCC.	**Decision** OCC advises that the agreed time on removal of service will be 16:00. Air Traffic requires extra time to introduce increased aircraft separation due to loss of enroute radar service in Texarkana air traffic sector OCC issues NOTAM on Texarkana ARSR service. **NOTAM issued** NOTAM issued. **Event ticket updated** Event ticket updated.	Telephone Telephone NOTAM screens Event ticket screens
16:00	**Clean-up begun** HAZMAT team begins cleanup.	**Remote adjustment** OCC removes ARSR from service remotely. Remotely turns off operating channel. **Specialist contacted** Advises site Specialist that OCC will advise when specialist can replace Pulse Transformer. **Parts availability confirmed** Confirms availability of replacement transformer. **Event ticket updated** Updates event ticket.	RMM screens Telephone Logistics information system screens Event ticket screens

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
18:00 24:00 04:00 (Day 2)	**Clean-up underway** HAZMAT team continuing clean up.	**Event ticket updated** OCC updates event ticket every 4 hours with status until event ticket is closed.	Event ticket screens
06:00	**Clean-up completed/ event ticket updated** HAZMAT team advises OCC that spill is cleaned up and site is safe to resume operation.	**Event ticket acknowledged** OCC acknowledges HAZMAT entry. **Remote adjustment** Remotely returns power to operating Channel B. **Certification** Certifies Channel B remotely. **Specialist contacted** Calls specialist to site to replace transformer in channel A. **NOTAM canceled** OCC cancels NOTAM	Event ticket screens Facility RMM screens Facility certification screens. Workforce management screens NOTAM screens
06:15	**Restoration of service confirmed** Facility operating Channel B Channel A unavailable NOCC & Air Traffic acknowledges service restoration. Air Traffic resumes normal flow in Texarkana sector.		Facility status screens Facility RMM screens
06:45	**Specialist arrives at site** Specialist arrives at site to replace transformer Channel A.	**Specialist's arrival acknowledged** OCC acknowledge specialist arrival at site.	Event ticket screens Workforce management screens
08:00	**Repair completed** Specialist completes replacement of transformer. **Repair verification requested** Specialist requests OCC to verify operation of Channel A. **Control transferred** Specialist transfers control of site to OCC.	 **Repair verification request acknowledged** OCC acknowledges request. **Remote adjustment** OCC assumes control of site remotely. Makes switch from channel B to A.	Facility status screens Event ticket screens Facility RMM screens

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
08:01	**Restoration of service confirmed** Texarkana operating on Channel A. Site specialist reports on event ticket that everything is "Green" at site.		Event ticket screens
		Certification OCC certifies service .	Facility certification screens
		ATC informed of status OCC advises ATC that site is fully restored.	Telephone
	Specialist departs site Specialist departs site.	**Event ticket closed** OCC closes event ticket.	Event ticket screens
08:02	NOCC acknowledges closure of Event ticket.		Event ticket screens

Scenario 4 - Loss of Airport Surveillance Radar/MODE-S Data

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
13:00	**Equipment failure** San Antonio Airport Surveillance Radar (ASR)/MODE-S failure. **ATC involved** ATC immediately suspends arrivals/departures.	**Status flagged** Status indicator shows San Antonio Airport Surveillance Radar/MODE-S has failed and is off line. **Event ticket opened** Event ticket is opened. **Remote adjustment fails** OCC attempts to reset ASR does not respond.	Facility status screens Event ticket screens Facility RMM screens
13:01		**ATC informed of status** OCC advises ATC that transition to Center Radar Processing is necessary.	Autodial (Telephone)
13:02		**Remote adjustment** OCC transitions San Antonio Terminal Radar Approach Control to Center Radar Processing.	Facility RMM screens
13:03	**ATC involved** ATC resumes operations with appropriate flow restrictions for Center Radar Processing operations.	**ATC informed of status** OCC advises ATC that Center Radar Processing is available. at San Antonio **Certification** Certifies San Antonio Center Radar Processing service.	Autodial (Telephone) Facility certification screens
13:04	**Event: Inclement weather** Inclement weather approaches Keller ARSR Long Range Radar site.		Next Generation Weather Radar screens
13:06		**Status flagged** OCC observes emergency generators come up at the Keller Long Range site.	Facility Status screens
13:07		**Specialist contacted** OCC contacts responsible specialist and work center regarding San Antonio Airport Surveillance Radar/MODE-S failure.	Workforce management screens Autodial (telephone) pager
13:08	**Specialist reached** Specialist responds to OCC's restoration call to San Antonio ASR site.	**Specialist's arrival awaited** OCC awaiting specialist arrival at site.	Telephone

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
13:14	**Event: Equipment failure** Channel fails at Keller ARSR site (Channel A). Site automatically transfers to Channel B.	**Alarm** Alarm occurs at Keller Long Range site. **Event ticket opened** Open event ticket	Facility status screens Event ticket screens
13:15		**Alarm acknowledged** OCC acknowledges alarm at Keller long range site. **Remote adjustment** Resets Channel A. Channel A recovers OCC transfers ARSR back to Channel A. **Event ticket closed** Closes event ticket.	Facility RMM screens Facility RMM screens Event ticket screens
13:15	**Specialist arrives at site** Specialist arrives at San Antonio ASR site. **Event ticket updated** Specialist updates event ticket on arrival. **Troubleshooting** Specialist begins troubleshooting Airport Surveillance Radar/MODE-S.	**Alarm** OCC observes intrusion alarm at San Antonio Airport. Surveillance Radar/MODE-S site. **Specialist's arrival acknowledged** Receives onsite specialist acknowledgment of event ticket.	Status monitoring screens Event ticket screens
13:20	**Diagnosis** Specialist finds that antenna drive motor circuit breaker has tripped. **Event ticket updated** Updates event ticket with diagnosis.	**Diagnosis acknowledged** OCC acknowledges updated event ticket with diagnosis.	Status monitoring screen event ticket screens
13:25	**Repair begun** Specialist resets circuit breaker Unable to determine cause **Event ticket updated** Updates event ticket.	**Event ticket entry acknowledged** OCC acknowledges updated event ticket.	Facility status monitoring screens Event ticket screens
13:30		**Contacts Specialist** OCC advises specialist to remain at San Antonio site to monitor commercial power and breaker.	Autodial (Telephone)

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
13:45	**Repair completed** Specialist advises operation normal, continuing to observe breaker, monitoring temperature of breaker.	**ATC informed of status** OCC advises ATC that San Antonio ASR and Mode-S is available.	Autodial (Telephone) Certification screens
13:46	**Event: Flight check** Flight Check aircraft will arrive early to flight check ILS at Ft. Worth Meachum (Fort Worth) Airport.	**Phone call received** OCC receives call from Flight Check Control Center in Oklahoma City notifying that Flight Check aircraft will arrive early. **Event ticket opened** Opens event ticket.	Telephone E-mail Facility status screens Event ticket screens
13:47	**Transition requested** ATC requests transition back to San Antonio Terminal Radar/MODE-S service.	**Remote adjustment** OCC transitions San Antonio Terminal Radar Approach Control to terminal Radar/MODE-S service . **Certification** OCC certifies service. **Event ticket updated** OCC updates event ticket.	Facility RMM screens Certification screens Event ticket screens
13:51		**Supervisor contacted** OCC contacts Fort Worth work center supervisor to notify him that Flight Check aircraft will arrive early to perform flight check on ILS.	Workforce management screens Autodialing (telephone)
13:52		**Specialist contacted** OCC contacts Fort Worth work center specialist and notifies him that Flight Check is coming early to perform flight check.	Workforce management screens FM Radio
13:53		**ATC informed of status** OCC contacts ATC regarding Flight Check. **National Air Flow involved** OCC coordinates with Air Traffic flow.	Telephone Telephone Event ticket screens
14:01	**Restoration of service confirmed** ATC resumes normal operations. Reports San Antonio Mode-S working normally.	**Event ticket updated** OCC updates event ticket to show that ATC operations are normal. **Event ticket closed** OCC closes event ticket.	Event ticket screens Event ticket screens

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
14:10	**Event ticket updated** Specialist updates event ticket to indicate that San Antonio Mode-S working normally. **Specialist departs site** Specialist departs San Antonio terminal radar site.	**Repair notification acknowledged** OCC acknowledges event ticket update concerning repair of San Antonio Mode-S. **Event ticket closed** OCC closes event ticket.	Event ticket screens Workforce management screens Event ticket screens
14:15	**Specialist arrives at site** Specialist arrives at Ft. Worth Airport. **Control requested** Specialist requests control of ILS for Flight Check.	**Control transferred** OCC acknowledges, and releases Fort Worth ILS to specialist. **Remote adjustment** ILS removed from service.	FM Radio Event ticket screens Facility RMM screens Facility RMM screens
16:00	**OCC informed of status** Specialist calls OCC and reports Flight Check at Forth Worth completed. System ready to be returned to service.	**Status report acknowledged** OCC acknowledges specialist. **Certification** OCC certifies Fort Worth ILS service.	FM Radio (National Radio Communications System) Facility certification screens
16:05	**Specialist departs site** Specialists departs Fort Worth site.	**ATC informed of status** OCC informs ATC that ILS at Forth Worth Airport is available for service. Event ticket closed.	Event ticket screens
16:10		**Remote investigation** OCC makes a fault history analysis and discovers breakers have repeatedly failed at several other ASR sites besides San Antonio. **Authorities notified** OCC contacts engineering support and notifies them of failure history. Refers engineering support to event ticket.	Fault history screens Telephone/e-mail Event ticket screens

Scenario Time	External to OCC	Internal to OCC	Technology/information Available at OCC
16:25	**OCC informed of status** Engineering support confirms that this circuit breaker has a history of failure, advises that a modification kit to replace all breakers of this type will be available soon.	**Specialist contacted** OCC advises specialist of findings.	Event ticket screens Fault history screens Telephone

Appendix B

Scenario Errors

Scenario 1

SCENARIO 1	Number of Panel Members Rating Importance as:			Mean Rating (n=9)
POTENTIAL ERROR OR CONCERNS	**Low (1)**	**Med (2)**	**High (3)**	
Overlook need of a critical backup facility (facilities required are not fixed)	0	1	8	2.9
Failure to share status information among all OCC staff	0	1	8	2.9
Failure to acknowledge and coordinate information	0	2	7	2.8
Event ticketing errors	0	2	7	2.8
Failure of AF and AT to communicate	0	3	6	2.7
Inadequate information feedback	2	2	5	2.3
Lack of responsibility for an event ticket	2	2	5	2.3
Forgetting an event ticket	2	2	5	2.3
Errors from failure to update or close out event ticket	0	4	4	2.5[a]
Errors because specialists fails to respond	0	5	4	2.4
Errors from no access to scheduled outage information	1	4	4	2.3
OCC & Flow Control fails to coordinate WAAS outage	1	4	4	2.3
Errors from incomplete WAAS coordination	2	3	4	2.2
Errors from lack of procedures if lose WAAS (Need to know consequences of releasing facilities)	2	3	4	2.2
Errors from WAAS being "green" and fully operational but not be certified	3	2	4	2.1
Event ticket procedures not standardized	3	2	4	2.1
Event ticket error entry	0	5	3	2.4[a]
Errors from specialist not acknowledging service request	0	6	3	2.3
Errors from not properly initiating event tickets	1	5	3	2.2
Errors from an improperly or erroneous status board	1	4	3	2.2[a]
Errors because airspace users/pilots do not get information	2	4	3	2.1
Errors because multiple event tickets are open for a single event	3	2	3	2.0[a]
Data entry errors or other judgement type errors	3	2	3	2.0[a]
Failures from retrieving wrong event ticket	4	1	3	1.9[a]
Failure to properly use communication channels	0	7	2	2.2
Errors from people not being notified	1	6	2	2.1
Errors from not knowing where specialists are	1	6	2	2.1
Errors due to too many data sources	1	6	2	2.1
Errors concerning notification of work completion	1	5	2	2.1[a]
Errors when equipment fails and is not reported	2	5	2	2.0
Errors from failure to disseminate WAAS failure information	2	5	2	2.0
Errors from too many OCC verbal communications	4	3	2	1.8
Errors from over reliance on event ticket	4	2	2	1.7[a]
Errors from improper closure of event tickets	4[b]	4	1	1.7
Errors from poor human judgment to open event ticket	5	3	1	1.6
Menu picks on event tickets can lead to error	5	2	1	1.5[a]
Failure to open event tickets in timely manner	6	2	1	1.4
Errors from poor NOTAM preparation & not verified	3	6	0	1.7
Failure to recognize message as an alert	5	4	0	1.4

[a] One panel member failed to rate this problem, so n=8 for this mean.
[b] One panel member rated this problem at low/medium importance. This was scored as 1.5.

Scenario 2

SCENARIO 2	**Number of Panel Members Rating Importance as:**			**Mean Rating (n=9)**
POTENTIAL ERROR OR CONCERN	**Low (1)**	**Med (2)**	**High (3)**	
Terminology differences between AF and AT	0	1	8	2.9
Common thread not recognized for problems	0	2	7	2.8
Errors due to the context in which AF works with AT (remote link versus face-to-face)	1	1	7	2.7
Maladjustment of radar because specialist does not have access to real-time radar data	1	1	7	2.7
Specialists do not see functional relationships	0	3	6	2.7
Failure to supervise field specialist	0	4	5	2.6
Specialist makes error in prioritizing events	1	3	5	2.4
The work center, the OCC, and the site personnel (or no one) tries to fix same problem, same time	1	3	5	2.4
Multiple failures in a geographic area require too wide a range of knowledge	1	3	5	2.4
Overload of events	1	4	3	2.3
Incomplete problem description on event ticket	0	6	3	2.3
Radar not properly diagnosed	1	5	3	2.2
Radar problem determination	2	4	3	2.1
Questionable documentation practices	1	6	2	2.1
Questionable judgement in resolving frequency interference	4	4	1	1.7
Insufficient support to change out antenna	3	5	1	1.8
Not enough time to open event tickets	4	4	1	1.7
Calling the wrong specialist	4[a]	4	1	1.7
Specialist does not hear radar alarm	5	3	1	1.6
Technical data entry failure (confusing acronyms)	0	8	0	2.0[b]

[a] One panel member rated this problem as being of Low/Medium importance. This was scored as 1.5.
[b] One panel member failed to rate this problem, so n=8 for this mean.

Scenario 3

SCENARIO 3	**Number of Panel Members Rating Importance as:**			**Mean Rating (n=9)**
POTENTIAL ERROR OR CONCERN	**Low (1)**	**Med (2)**	**High (3)**	
Specialist fails to recognize HAZMAT	0	2	7	2.8
OCC specialist loses initiative “ownership"	2	0	7	2.6
Not able to find the right contact information	0	3	6	2.7
Contact database out of date	0	4	5	2.6
Inadequate OCC emergency staff	0	4	5	2.6
Reporting leads to missing problem	0	4	5	2.6
Excessive paperwork interferes with job	0	4	5	2.6
OCC specialist inappropriately certifies system	0	4	5	2.6
Information reporting system fails	0	4	5	2.5
Test equipment not on site	1	3	5	2.4
Inflexibility prevents resolution of problems	1	3	4	2.4[a]
Event ticket response responsibility	0	6	3	2.3
Specialist lacks configuration information	0	6	3	2.3
Overlapping OCC activities causes problems	1	5	3	2.2
Intrusion alarm ignored	1	6	2	2.1
HAZMAT team bumped switch	2	5	2	2.0
Specialist cannot find radar site location	0	8	1	2.1
Non-standard procedures lead to errors	0	8	1	2.1
OCC specialist does not know HAZMAT procedures	0	8	1	2.1
OCC does not understand remote site RMS alert	1	7	1	2.0
OCC specialist fails to notify union representative	1	8	0	1.9
Call for HAZMAT procedures when unnecessary	2	7	0	1.8

[a] One panel member failed to rate this problem, so n=8 for this mean**.**

Scenario 4

SCENARIO 4	**Number of Panel Members Rating Importance as:**			**Mean Rating (n=9)**
POTENTIAL ERROR OR CONCERN	**Low (1)**	**Med (2)**	**High (3)**	
Database not updated	0	2	7	2.8
Fails to check if backup radar is in service	0	3	6	2.7
Wrong priority for event ticket	0	4	5	2.6
Recurring problem not solved	0	4	5	2.6
Event ticket generated for insignificant events	0	5	4	2.4
AT not notified about MODE-S radar availability	0	5	4	2.4
Uncertified MODE-S radar placed in service	1	4	4	2.3
Event ticket not updated to reflect early arrival	0	6	3	2.3
Work center does not know Channel A was remotely reset	0	7	2	2.2
OCC does not understand event ticket system	1	6	2	2.1
Workgroup not prepared for early flight check	0	8	1	2.1
Insignificant event reported	1	7	1	2.0
Specialist fails to update event ticket to reflect access to the site	0	9	0	2.0