Active Confinement System Upgrade Team

Office of Environmental Management

Proposed Upgrades to Confinement Ventilation Systems

Review Report and Recommendations

June 25, 2010

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Team Member Signatures, denoting concurrence with the Team's Report:

Dr. Steven L. Krahn

James A. Hutton

Michael Mikolanis

James Wicks

Executive Summary

1.0 INTRODUCTION

In response to Defense Nuclear Facilities Safety Board Recommendation 2004-2, *Activê Confinement Systems*, the Department performed evaluations of confinement systems. The overall focus of these system evaluations was to:

1. verify that appropriate performance criteria are derived for ventilation systems,
2. verify that these systems can meet the performance criteria, if applicable, and
3. determine if any physical modifications are necessary to enhance safety performance.

The Active Confinement System Upgrade Team (Team) was chartered in a memo from the Principal Deputy Assistant Secretary for Environmental Management, dated 01/25/2010 (Attached). The purpose of the Team was to evaluate modifications recommended (from item 3 above) for EM facilities and provide DOE decision makers a way to focus on and prioritize those modifications to active confinement ventilation systems that are most likely to significantly improve safety performance across the EM facilities that were evaluated under 2004-2. The Team was charged with providing a prioritized list of upgrades to confinement ventilation and supporting systems for EM facilities evaluated under 2004-2.

2.0 SCOPE OF REVIEW

The Team reviewed the confinement ventilation system performance gaps identified in the individual Site Evaluation Team reports, the proposed upgrades to confinement ventilation and supporting systems to close those gaps, and provided recommendations to senior EM management regarding the priority of these upgrades for implementation. As part of its work the team developed criteria for how this prioritization was established.

The Team developed criteria associated with Radiological Protection and System Reliability/Maintainability to assess the gaps qualitatively. These "High, Medium and Low" criteria (defined below) were used to assess each "gap"; the gaps had been previously determined by site evaluation teams using criteria developed in accordance with the DOE Implementation Plan (IP) for the Board's Recommendation. This allowed an initial screening of the gaps to develop a population of highest priority gaps that would then be prioritized using rigorous, transparent and defendable quantitative analyses.

The Team used the Analytic Hierarchy Process (AHP), described below, to prioritize the top ten projects developed by the previous initial screening process.

The Review Team also applied Benefit-to-Cost analysis to further refine the AHP evaluation; this resulted in six projects (described below) being recommended to senior EM management for accomplishment.

Introduction/Background

In response to Defense Nuclear Facilities Safety Board Recommendation 2004-2, *Active Confinement Systems*, the Department performed evaluations of confinement systems. The overall focus of these system evaluations was to:

1. verify that appropriate performance criteria are derived for ventilation systems,
2. verify that these systems can meet the performance criteria, if applicable, and
3. determine if any physical modifications are necessary to enhance safety performance.

These evaluations were performed by Site Evaluation Teams (SET) using the *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems*, in accordance with the DOE IP for Board Recommendation 2004-2. DOE-EM used an Independent Review Panel (IRP) to ensure that the site reports appropriately reflect the ventilation system guidance, including the review criteria. The SETs and IRP determined that the ventilation systems met the requirements of their safety related functions, as applicable. As part of the ventilations system evaluations, the SET also performed an evaluation of the cost and benefit of proposed modifications to close any gaps between the facility ventilation capabilities and the guide's review criteria. The results of these cost and benefit evaluations are a list of potential upgrade projects for EM facilities, described in the individual site reports. These SET and IRP reports were reviewed by the DOE-EM Technical Authority Board (TAB) and the Chief Nuclear Safety.

The Active Confinement System Upgrade Team (Team) was chartered in a memo from the Principal Deputy Assistant Secretary for Environmental Management, dated 01/25/2010 (attached). The purpose of the Team was to evaluate potential modifications (from item 3 above) for EM facilities and provide DOE decision makers a way to focus on and prioritize those modifications to active confinement ventilation systems that are most likely to significantly improve safety performance across the EM facilities that were evaluated under 2004-2, since the prior SET/IRP reviews had determined that the systems met safety related requirements of the applicable safety basis. The Team was charged with providing a prioritized list of upgrades to confinement ventilation and supporting systems for EM facilities evaluated under 2004-2.

Team Composition

Team Chair:	Dr. Steven L. Krahn (EM-20)
Team Members:	James Hutton (EM-20)
	Michael Mikolanis (DOE-SRS)
	James Wicks (DOE-ORP)
Consultants:	Dr. David Gallay
	Dr. Wayne Andrews

Review Process

Overview of Review Process and Recommendation Development

The Team went through each of the gaps that had been identified by the Site Evaluation Teams (SETs) to determine the impact that their closure would have on Radiological Protection and System Reliability/Maintainability, using qualitative criteria discussed below. Ten gaps clearly stood out as having more impact than the others. These 10 potential projects were then further evaluated, taking into account the Team's evaluation of the relative cost of each project, based on raw cost data provided by the SETs. This benefit-to-cost analysis was further refined by bringing the cost information up to date (in FY10 dollars) and applying appropriate uncertainties to the cost estimates. This evaluation indicated that six (6) of the potential projects had significantly higher impact (benefit-to-cost) than the others.

Review Process Description

The Team reviewed the confinement ventilation system performance gaps identified in the individual SET/IPR reports, the proposed upgrades to confinement ventilation and supporting systems to close those gaps, and provided recommendations to EM management regarding the priority of these upgrades for implementation. As part of its work the team developed criteria for how this prioritization was established.

The Team developed criteria associated with Radiological Protection and System Reliability/Maintainability to assess the gaps qualitatively. These "High, Medium and Low" criteria were used to assess each gap relative to the Board's Recommendation and the DOE IP commitments. The criteria developed by the Team are:

- Radiological Protection:
  - High-Avoids or mitigates release of contamination to the environment, or a large release within the facility due to operational upsets.
  - Medium-Minimizes potential for spread of contamination within the facility due to operational upsets.
  - Low-Minimal improvement in RP functions and little or no change in functionality of the CVS.
- Reliability/Maintainability
  - High-Improvement in the integrity of the confinement boundary such that the CVS is capable of performing its confinement function under most plausible operational upset conditions.
  - Medium-Adds or restores CVS functionality, identified as a gap in the CVS evaluation, where no alternative means of performing the function is available within the facility systems.
  - Low-Marginal or no impact on maintenance requirements, system availability or defense in depth posture of the CVS.

In an initial Team meeting, the Team members discussed the approach to be used for the review, and the scope of the review task. The Team Chair assigned different sites to the Team members to conduct field visits and gather information in order to familiarize themselves with the facilities and gaps. The Team then met, and each gap was assessed by the Team using the above criteria. The Team discussed each gap, evaluated the vulnerabilities it entailed, and then developed consensus assessments for each gap of High, Medium, or Low in the areas of both Radiation Protection and Reliability/Maintainability.

This allowed the Team to screen the gaps to develop a population of the highest priority gaps that would then be prioritized using rigorous, transparent and defendable quantitative analyses. The Team used the Analytic Hierarchy Process (AHP) and the *Expert Choice* ™ software (an industry standard tool) to prioritize the top ten projects.

The Analytic Hierarchy Process (AHP) is a structured technique for dealing with complex decisions. Rather than prescribing a "correct" decision, the AHP helps the decision makers find the one that best suits their needs and their understanding of the problem.

The AHP was developed in the 1970s[1] and has been extensively studied and refined since then. The AHP provides a comprehensive and rational framework for structuring a decision problem, for representing and quantifying its elements, for relating those elements to overall goals, and for evaluating alternative solutions. Once the hierarchy is built, the decision makers systematically evaluate its various elements by comparing them to one another, two at a time (i.e., pair-wise comparison). In making the comparisons, the decision makers use concrete data about the elements, supplemented by their judgment about the elements' relative meaning and importance.

The AHP converts these qualitative evaluations to numerical values that can be processed and compared over the entire range of the problem; a numerical weight or priority is derived for each element of the hierarchy, allowing diverse and often incommensurable elements to be compared to one another in a rational and consistent way. This capability distinguishes the AHP from other decision making techniques. In the final step of the process, numerical priorities are calculated for each of the decision alternatives. These numbers represent the alternatives' relative ability to achieve the decision goal, so they allow a straightforward consideration of the various courses of action.

In applying the AHP to the prioritization of the top ten gap closure modifications, the Team established a decision goal of "Maximize Radiation Protection as a Function of Cost and Ability to Implement", with improvement to Reliability and Maintainability as a secondary goal. To meet the goal, the Team established hierarchy Objectives and weightings as follows: "Improve Radiation Protection Function" – 69.6%, "Cost" – 22.9%, and "Improve CVS Reliability and Maintainability" – 7.5%. The Team then performed pair-wise comparisons, reaching a consensus rating for each pair, of each gap

[1] T.L. Saaty, *The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation,* McGraw-Hill, NY, 1980.

closure with respect to each of the objectives. Utilizing the *Expert Choice* ™ software, the Team developed relative rankings of the top ten gap closure modifications. The Team also performed sensitivity analysis regarding the weights of the three objectives; all the selected modifications maintained their relative priorities when the Radiation Protection and Cost attributes were made equal, with one exception (gap closure SRS/SRNL Gap 21 went to the top of the list, clearly as a result of the low cost of this modification).

Finally, the Review Team also applied Cost/Benefit analysis to the AHP data. Utilizing the preliminary cost estimates for the gap closure modifications, the team developed point estimates (at a 50% probability of success) for the cost of the modifications, and escalated these costs to FY 2010 (see Appendix A, *Developing the Point Cost Estimate).* Melding the methods of the AHP analysis and the Cost/Benefit analysis, the Team developed the final prioritized list of gap closure modifications:

Prioritized Project List -- Team's AHP Raw Scores			
Alternatives	B/C Ratio	Investment Cost (FY10 $M)	Cumulative Costs ($M)
SRS/SRNL Gap 21	0.796	$0.1	$0.1
SRS/F/H Labs	0.098	$1.2	$1.3
SRS/SRNL Gaps 1/5, 26, 38	0.094	$1.2	$2.5
SRS/SRNL Gaps 8-12 & 28-32	0.080	$1.1	$3.7
Hanford/WESF	0.050	$3.9	$7.6
SRS/SRNL Gaps 35, 37,39, 40,42	0.045	$2.3	$9.9
SRS/SRNL G 3,4 &, 6	0.009	$17.7	$27.6
Hanford/WRAP	0.006	$5.6	$33.2
Hanford 2706T	0.003	$11.3	$44.5
T-Plant	0.002	$28.2	$72.6

Results

Recommendations
The Team recommended the 6 highest priority gap closure modifications should be undertaken. The Team also recommended that EM commit to updating the Defense Nuclear Facilities Safety Board in one year on progress in achieving gap closure.

As recommended by the Team, these are the 6 highest priority gap closure modifications, along with a brief description of the impact of closing them:

- **SRS/SRNL Gap 21** - Failure of online glove box exhaust fan does not automatically start the standby fan. Eliminates the potential for a large in-facility release.

- **SRS/F and H Labs** - The building layout does not provide confinement zone separation. Pressure instrumentation to monitor differential between building interior and outside environment is not available. Proposed gap correction is enclosing laboratory corridors with doors, installation of a secondary set of doors at west side exterior exit, and provision of zone differential pressure monitoring systems.

- **SRS/SRNL 1/5, 26, 38** - Ductwork blanks are not provided between all adjacent filter banks. Interlocks are not provided between the supply and exhaust systems. Automatic backup electrical power is not provided for the High Bay Exhaust and Hood Exhaust. Prevents release of contamination to the environment if adjacent filter bank has a failure. Strengthens integrity of confinement boundary.

- **SRS/SRNL 8-12, 28-32** – "Tertiary" areas are surrounded by secondary areas, and have direct, unfiltered exhaust. For tertiary areas, closure of these gaps adds a low leak isolation damper on each system and interlocks the damper and fan control with the primary confinement zone exhaust.

- **Hanford/WESF (Waste Encapsulation Storage Facility)** - Wet Storage of 1335 Cs137 and 601 Sr90 capsules. K1 HEPA filter testing does not meet ASME N510. The K3 underground system was wetted some years ago and is suspect. Replacement of the existing K1 and K3 CVS into a single compliant CVS would restore confidence in the Canyon CVS, enable the Canyon and hot cells to be available for activities other than storage (e.g. repackaging of a ruptured capsule), and provide a safer environment for the largest source term on the Hanford Site.

- **SRS/SRNL 35, 37, 39, 40, 42** - E Bay Exhaust sub-system airflow exceeds HEPA filter rated capacity. E Hood Exhaust sub-system does not have redundant fans. Two locations have airflow greater than the rated capacity of the HEPA filter.

HEPA filters are not provided with DP instrumentation for the Lab and Storage Exhaust sub-system. HEPA filters configuration does not meet the filter housing pressure boundary integrity testing requirements in N510.

These gap closure modifications showed the greatest benefit in achieving the goal of "Maximize Radiation Protection as a Function of Cost and Ability to Implement", and were clearly separated from the last 4 gap closure modifications in terms of Benefit (as described by the AHP data for Radiation Protection and CVS Reliability and Maintainability) to Cost Ratio.

The Team Chairman briefed EM-1 on the Team recommendations. EM-1 accepted the recommendations, and directed the Savannah River (SRS) and Richland (RL) Field Offices to initiate detailed planning and identify funding for the 6 recommended gap closure projects in FY10 and FY11.

Both SRS and RL have begun refining the cost estimates for the projects, and are in the process of identifying funding.

Planned completion dates of the projects at SRS are:

SRNL Gap 21	5/08/12
F/H Analytical Laboratory Gap 1	2/28/2012
SRNL Gaps 1-5, 26, 38	2/16/2012
SRNL Gaps 8-12, & 28-32	6/08/12
SRNL Gaps 35, 37, 39, 40, 42	6/12/2012

At RL, planned completion of the WESF ventilation upgrade is 11/2012.

Active Confinement System Upgrade Team
Office of Environmental Management
Proposed Upgrades to Confinement Ventilation Systems

Appendix A. Developing the Point Cost Estimate

This appendix describes the process the Review Team used in deriving the point estimates of the predicted FY10 investment costs used in the benefit cost ratio analysis.

The basis of the predicted FY10 point estimates were the estimates developed at SRS and ORP in 2006. Some of those 2006 estimates were presented in terms of ranges; others were presented as point estimates.

Table A-1 depicts the 2006 cost estimates for the projects grouped in 10 alternatives. The first column of the table identifies the alterative number. The second column identifies the location of the project. The third column identifies the projects (referred to as "gaps") that comprise the alternative. For instance, Alternative 1 comprises three projects, identified as Gaps 3, 4, and 6. The last column shows the cost estimates—either as ranges or point estimates, depending on how they were submitted to the Review Team.

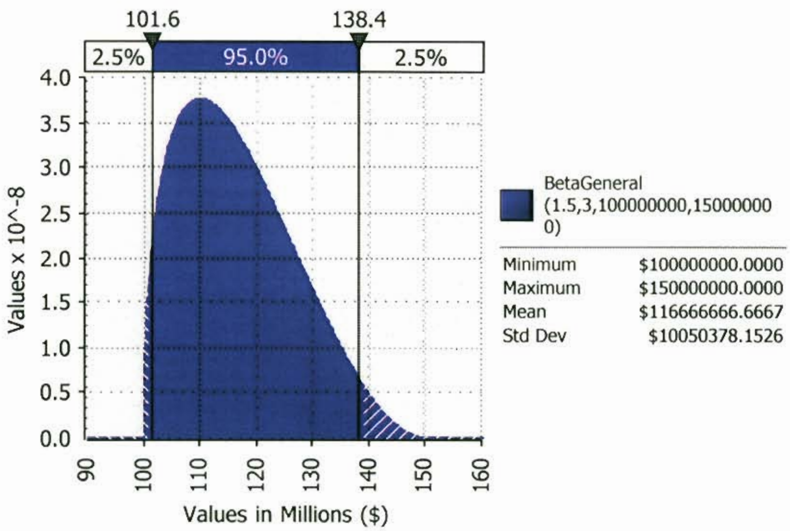
Table A-1. Original Cost Estimates for the 10 Alternatives

Alternative #	Site	Projects	Cost ($ million)
1	SRS/SRNL	Gaps 3, 4, and 6	14.00 – 21.00
2	SRS/SRNL	Gaps 35, 37, 39, 40, and 42	2.00 – 2.30
3	SRS/SRNL	Gap 21	0.10 – 0.20
4	SRS/SRNL	Gaps 1/5, 26, 38	0.87 – 1.54
5	SRS/SRNL	Gaps 8-12, 28-32	0.90 – 1.35
6	SRS/F/H Labs	Gap 1	0.84 – 1.70
7	Hanford/WESF	Gap 1	0.50 – 5.00
8	Hanford/WRAP	Gap 1	5.00
9	Hanford/T-Plant-221	Gap 1	25.00
10	Hanford/2706-T	Gap 3	10.00

Using the provided cost estimates, the Review Team inferred the original estimators' reasoning for the ranges or point estimates and then imputed a probability density function to reflect the likely uncertainty associated with each cost estimate. The Review Team then escalated the 2006-vintage cost distribution to a 2010 equivalent.

For example, assume that the Review Team was provided an estimated cost range of $100 million to $150 million. Given the relatively wide range, the Team would assume that original estimator felt that there was an order of magnitude level of accuracy with a $100 million estimate that could be as much as 50 percent higher. The underlying probability density function could be envisioned as in Figure 1.

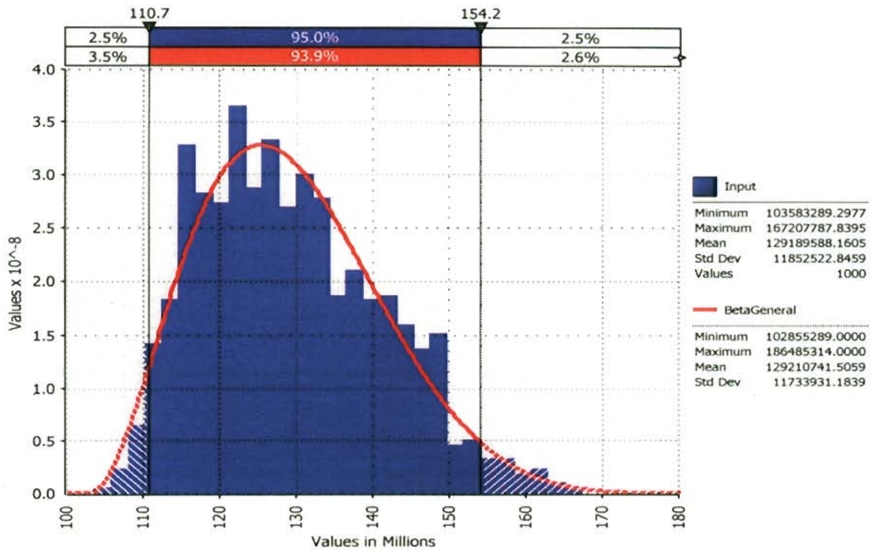
Figure A-1. Probability Density Function for the Cost of the Illustrative Example



This distribution is a beta distribution that ranges from $100 million to $150 million, with shape parameters of 1.5 and 3. The preponderance of probability mass is centered closer to the left side of the distribution. This suggests that the Team assumed the estimator thought the actual cost would more likely fall in the $100 million to $125 million range. However, the Team also assumed that the estimator thought that there was a risk that the actual cost could be much higher, e.g., somewhere in the $125 million to $150 million range. Yet, this risk is relatively low.

The escalated distribution is at Figure 2. The Team would then summarize this distribution by the distribution's mean value of $135 million and associated standard deviation of $12.9 million.

Figure A-2. Escalated Probability Density Function of the Cost for the Illustrative Example



For the original estimates that were presented as point estimates, the Review Team assumed an order of magnitude level of accuracy: plus 35 percent above the stated estimate and minus 10 percent below the stated estimate.[1] The Team then developed probability density functions as described above, escalated them, and developed the mean and standard deviation summary statistics.

[1] This is the typical guideline for an order of magnitude level of accuracy estimate, as prescribed by AACE International in its Recommended Practice No. 18R-97, Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries.

Department of Energy
Washington, DC 20585

January 25, 2010

MEMORANDUM FOR JEFFERY M. ALLISON
MANAGER
SAVANNAH RIVER OPERATIONS OFFICE

SHIRLEY OLINGER
MANAGER
OFFICE OF RIVER PROTECTION

FROM: DAE Y. CHUNG
PRINCIPAL DEPUTY ASSISTANT SECRETARY
FOR ENVIRONMENTAL MANAGEMENT

SUBJECT: Participation in a Confinement Ventilation Review Team

The review results for Environmental Management (EM) site evaluation reports of facility ventilation capabilities performed by Headquarters was completed in December 2009. These reports fulfill commitment 8.6.5 of Defense Nuclear Facilities Safety Board Recommendation 2004-2, *Confinement Ventilation.*

EM's Technical Authority Board (TAB) will sponsor a crosscutting review of these potential upgrade projects, in order to ensure consistency among sites, complete several reviews that the TAB directed to be re-performed, and establish an integrated priority list. The crosscutting review will be completed by March 2010. The potential upgrade projects cover several facilities, particularly those managed at the Savannah River Site and the Hanford Tank Farms.

The crosscutting review will be performed by a small team of experts led by Dr. Steven L. Krahn, Deputy Assistant Secretary for Safety and Security Program, as explained in the attachment. Mr. Michael Mikolanis and Mr. James Wicks at your respective sites have been identified as experts, and I am asking for your approval for their participation on this team and also for your support for their team related activities. This is a short duration activity (approximately 2 months) and should not require more than an estimated 2-3 weeks of their time during this period. Your approval for their participation may be provided directly to Dr. Krahn.

If you have any questions or need additional information, please contact me at (202) 586-7709 or Dr. Krahn at (202) 586-5151.

Attachment

Printed with soy ink on recycled paper

Department of Energy
Environmental Management
Active Confinement System Evaluation Review Team

Charter

Purpose

This Charter describes the Active Confinement System Evaluation Review Team, (hereinafter referred to as the 'Team'), within the Department of Energy (DOE) Office of Environmental Management (EM). The purpose of the Team is to review proposed upgrades to confinement ventilation and supporting systems and provide recommendations to EM management (including the EM Technical Authority Board) regarding the priority of these upgrades for implementation. As part of its work the Team will develop criteria for how this prioritization is established.

In response to Defense Nuclear Facilities Safety Board Recommendation 2004-2, *Active Confinement Systems*, the DOE performed evaluations of confinement systems. The overall focus of these system evaluations was to:

1. Verify that appropriate performance criteria are derived for ventilation systems;
2. Verify that these systems can meet the performance criteria, if applicable; and
3. Determine if any physical modifications are necessary to enhance safety performance.

The purpose of this Team is to evaluate modifications recommended (from item 3 above) for EM facilities and provide DOE decision makers a way to focus on and prioritize those modifications to active confinement ventilation systems that are most likely to significantly improve safety performance across the EM facilities that were evaluated under 2004-2.

Duration

The task of this Team is to provide EM with a prioritized list of upgrades to confinement ventilation and supporting systems for EM facilities evaluated under 2004-2 by March 31, 2010.

Membership

Dr. Steven L. Krahn (EM-20) will serve as the Team Chair.
James Hutton (EM-20), Michael Mikolanis (SRS) and James Wicks (ORP) will serve as Team members.

Additional personnel may be added by the Chair on an ad hoc basis to address specific issues or tasks.

Roles and Responsibilities

1. Chair
    a. Has overall responsibility for meeting the Team's goal of development of the prioritized upgrade list;
    b. Approves all Team agendum and meeting minutes; and
    c. Directs the work of Team members to ensure that Team evaluations are consistent with the needs of EM senior management and this charter.

2. Team Members
    a. Provide solutions, ideas, and suggestions for prioritization of EM's active confinement upgrades;
    b. Actively participates in Team activities and attends all Team meetings, unless excused;
    c. Assists the Chair to prioritize issues and initiatives and make decisions; and
    d. Brings knowledge of and is prepared to discuss perspectives and plans for issues relating to the upgrades being considered by the Team.

Meetings

The Team will meet as often as the Chair deems necessary to reach its goal. Given the short duration of this Team and the physical location of members, Team meetings may be conducted electronically (i.e., conference calls and televideo). The format for these meetings will be determined by the Chair.

Team Decision Making and Dispute Resolution Process

The Team will come to a consensus recommendation. Consensus is defined as general agreement or accord. Simply, this means that each Team Member is comfortable with the recommendation, even if it may not be his or her first choice. For Team purposes, consensus will mean at least two Team Members agree.