

**Network Reliability Performance Committee  
Best Practice Team  
Technical Paper**

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January 18, 1996**

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# Network Reliability Performance Committee

## Best Practice Team

### Technical Paper

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#### 1.0 Executive Summary

In June 1993, the Federal Communications Commission's (FCC) Network Reliability Council (NRC) published "Network Reliability: A Report to the Nation." This document contained technical papers written by the NRC Focus Teams. The focus teams, composed of experts both inside and outside the telecommunications industry, were established to conduct in-depth studies of seven network reliability areas that were considered to be of highest priority based on historical data, namely:

- Fiber Cable Systems
- Signaling Network Systems
- Switching Systems
- Digital Cross-Connect Systems
- Power Systems
- E-911 Systems (Focus Group IV)
- Fire Prevention.

The NRC encouraged the industry to study and assess the applicability of recommendations contained in the technical papers for implementation in their companies, with the following caveat: *"Not every recommendation will be appropriate for every company in every circumstance, but taken as a whole, the Council expects that these findings and recommendations will sustain and continuously improve network reliability."* The compendium of technical papers became known as the "Purple Book" and the recommendations therein became known as Best Practices. Note that the original focus teams made recommendations and identified Best Practices, already in use by individual companies, for consideration by the rest of the industry. The findings of the NRC were shared with the industry at a national symposium that was held in April of 1993. There were very few cases where the identified Best Practices were actually endorsed or recommended by the focus teams.

In fall of 1994, the NRC established new Task Groups. The Network Reliability Performance Committee (NRPC) was formed by the Alliance for Telecommunications Industry Solutions (ATIS) Network Reliability Steering Committee (NRSC) to fulfill the mission of the NRC's Task Group I to address network reliability performance. The NRPC chartered the Best Practice Team (BPT) to address the following issues assigned to it by the NRC:

1. Recommend and implement relevant measures of the industry's implementation of Best Practices.
2. Determine if and to what extent industry is implementing applicable Best Practices.
3. Evaluate the effectiveness of applicable Best Practice for avoiding or mitigating service outages.
4. Determine the cost/value of applicable Best Practices.
5. Determine if there are additional or new Best Practices that should be added to the current set being utilized in industry today.

The BPT, which has been addressing these issues for nearly a year, has analyzed data on an ongoing basis. These data were collected from individual companies and from FCC Outage Reports. The major conclusions and recommendations are as follows:

- There is a high level of awareness and implementation of Purple Book Best Practices.
- The Symposium and Purple Book were effective communication channels to the telecommunications industry.
- Competing companies can share experiences with processes and procedures to the benefit of customers as a whole and new entrants to the industry.
- Companies took seriously NRC's recommendations.
- Because of limitations in the data, some obvious conclusions may not be supported. For example, improved outage trends may or may not be directly related to the implementation or effectiveness of Best Practices because the data do not indicate a timeline of when they may have been implemented.
- Analyses of Best Practice sections of FCC Outage Reports indicate that the implementation of Best Practices is valuable in preventing and mitigating outages but does not guarantee that an outage will not occur.

- 90 percent of identified Service Provider Best Practices was determined to still be universally applicable by the BPT, based on data and evaluation of Obsolete and Alternate Solution responses.
- Only two Best Practices were found to be obsolete.
- New Best Practices are emerging resulting from learning and technology changes.
- Some alternative Best Practices are *not best*.
- Industry, including new entrants, should implement (continue to), evaluate, internally track, and monitor implementation of NRC Best Practices as modified and categorized by the BPT.
- Companies should use the *Tools* developed by the BPT for Best Practice implementation decision making, monitoring implementation, and outage reporting and analysis.
- Industry should continue to use industry forums such as the Network Operations Forum (NOF), NRSC, and Standards organizations such as Committee T1 to introduce new Best Practices and propose changes to or obsolescence of existing Best Practices.
- ATIS should take responsibility for maintaining and updating the BPT-developed *Tools*.

These conclusions and recommendations, as well as more detailed analyses of individual Best Practices, are further discussed in this technical paper. The BPT recognizes the overall effectiveness of industry Best Practices in maintaining network reliability and believes that industry must continue building on our findings.

## 2.0 Background

Subsequent to the publication of the Purple Book, the NRSC solicited input from carriers and manufacturers for inclusion in its first Annual Report, to better understand how they evaluate, implement, and share the ideas and Best Practices contained in the *Purple Book*. The NRSC solicitation input on the general approach to the following:

1. Follow-up on NRC recommendations.
2. Specific recommendations that have been implemented and shown to be effective.
3. Examples where implementation of Best Practices has resulted in improvement.
4. Feedback on whether NRC recommendations resulted in closer cooperation and coordination in the resolution of outages.

The input received by the NRSC took the form of lists of Best Practices identified and tracked by the responding companies, which included both exchange and interexchange carriers.

The (NOF) also reviewed and analyzed all NRC recommendations to identify potential NOF activities and issues. This resulted in the development of a matrix, mapping NOF activity and issues to the NRC recommendations and the introduction and resolution of five new issues.

The BPT assumed responsibility for the Best Practice lists received by the NRSC and compiled them in order to develop a common list of Best Practices contained in the Purple Book and agreed to by the industry. This formed the foundation for the data requests questionnaire spreadsheet, which is discussed in Section 4 of this report. At present, the BPT agreed that there were two audiences for the questionnaire: Service Providers and Equipment Suppliers. Best Practices that could not be implemented by individual companies were excluded from the data questionnaire spreadsheet. Examples of this are the “One Call” legislation and Benchmarking Study recommendations and the Internetwork Interoperability Testing recommendations, which could not be implemented without overall industry action or required external action such as legislation. These recommendations are addressed in Section 5 from a general industry perspective.

### 2.1 Deliverables and Work Plan

The BPT's next accomplishment was the development of goals and objectives in the form of deliverables based on the Issue Statement for Task Group (TG) I. They are as follows:

- Document how companies manage the process for tracking and implementing NRC recommendations
  - Organization
  - Measurement ownership
  - Status of individual company plans
  - Document distribution of NRC Document

- Document percentage level of implementation of Best Practice Team identified NRC recommendations by industry segment (statistical)
  - Percentage implemented (customized baseline list by responsible industry segment: service provider; vendor by equipment manufactured [e.g., switch, STP, SCP,...])  
Questionnaire will ask whether Best Practice is F (fully) or P (partially) ~~imple~~mented
  - Percentage planned
  - Percentage not planned
  - Alternate solution implemented
  - LEC data weighted by “access lines served”
  
- Document various categories of Best Practices
  - Preventative (BPT to categorize)
  - Mitigating (BPT to categorize)
  - Preventative and mitigating (BPT to categorize)
  - Obsolete
  - Cost to implement relative to other Best Practices: Very high, high, medium, low, or very low
  
- Demonstrate effectiveness of identified Best Practices for avoiding or mitigating service outages
  - Compare outage trends to implementation by focus group
  - Provide anecdotal examples of what worked well (optional essay question)
  - Provide industry assessment of effectiveness of those Best Practices implemented based on experience and individual company criteria, on a scale of "0 to 5."
    - ∴ 0 - Unknown
    - ∴ 1 - Not effective in preventing or mitigating outages
    - ∴ 2 - Less effective in preventing or mitigating outages
    - ∴ 3 - Somewhat effective in preventing or mitigating outages
    - ∴ 4 - Helpful in preventing or mitigating outages
    - ∴ 5 - Definitely effective in preventing or mitigating outages
  
- Determine if there are additional or new Best Practices
  - Consolidate and report on Best Practices identified by the other NRC Task Groups
  - Determine if additional Best Practices should be referred to other existing groups such as NOF, T1, and NRSC
  
- Evaluate if Best Practices have more applicability and effectiveness in certain geographical areas
  - Conduct an evaluation based on input from the Performance Metrics Team of TG I

The BPT Questionnaire included the data request for NRC Focus Group IV, *Essential Communications During Emergencies*, evaluation of the E9-1-1 Best Practices. The results of this data collection were sent to TG IV for their evaluation.

## **2.2 Organization of Technical Paper**

- Section 1**     Executive Summary
- Section 2**     Background
- Section 3**     Best Practice Team Members
- Section 4**     Data Collection and Analysis Methodology
- Section 5**     Best Practice Team Study Results
- Section 6**     Summary of Findings and Recommendations
- Section 7**     Acknowledgments
- Section 8**     Exhibits
- Section 9**     Appendix

### 3.0 Best Practice Team Members

The Best Practice Team Members are listed as follows:

**Task Group I/NRPC Chairman:**Ray Albers (Bell Atlantic)

**Mentor:** Frank Ianna (AT&T)

**Team Leader:**Rick Harrison (ATIS/NOF, Bellcore)

**Data Collector/Statistician:**Ken Grace (Bellcore)

Ron Binz	NASUCA
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Royce Davis	GTE
Elizabeth Ham	Southwestern Bell Telephone
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Tim Mack	Ameritech
Archie McCain	BellSouth
Jim Oeleis	U S WEST
Peter Shelus	AT&T
Jerry Usry	Sprint

The team would also like to recognize participation of the following people:

Bill Askwith	AT&T Network Systems
Rick Canaday	AT&T
Jackie O'Rourke	Sprint

## 4.0 Data Collection and Analysis Methodology

To fulfill its mission, the Best Practice Team determined that it required information from local exchange and interexchange service providers and from suppliers regarding their usage of the Best Practices recommendations. Accordingly, the team developed two data requests, one for service providers and one for suppliers, in order to obtain information about the following:

- The industry's processes for managing implementation of the NRC's Best Practices recommendations contained in *Network Reliability: A Report to the Nation*
- The extent of implementation of the recommendations
- The relative cost of implementation
- Ratings of their effectiveness.

The remainder of this section describes the questionnaires and the process used to administer them and summarizes the response rates from the industry.

### 4.1 Questionnaire Description

The data request consisted of three parts. Part 1 asked several questions about how a company is managing the *process* for tracking and implementing the Best Practices recommendations. Part 2, which was optional, invited the company to share information about Best Practices that have proved to be especially effective in reducing or avoiding network outages. Parts 1 and 2 were the same in both the service provider and supplier data requests. A copy of these parts of the questionnaire is provided in Appendix 2.

Part 3 was aimed at collecting statistical information on the extent of implementation of the individual recommendations, information on the costs to implement the recommendations, and an assessment of their effectiveness. This part was presented in table or spreadsheet form, listing the individual Best Practices recommendations and providing cells for responses to several questions about each recommendation. Separate versions were prepared for service providers and suppliers. Both a paper copy and an electronic copy were included in the request to service providers. The companies were asked to provide their responses in electronic form, if possible, and most did so. The supplier request had a shorter list of practices and was provided only in paper form.

The study team for Essential Communications During Emergencies (ECOMM Team) requested that the questions dealing with the E9-1-1 Best Practices be answered twice by the LECs, with respect to implementation in metropolitan and nonmetropolitan areas. The spreadsheet for service providers included provisions for these two sets of responses.

The spreadsheet for Part 3 of the data request had the following format. Column A contained an identifying number for each recommendation. Column B identified the NRC focus team that made the recommendation. Column C gave a brief summary statement of the recommendation, and

Column D provided a reference to the section of the Purple Book that discusses the recommendation in more detail.

Columns E through J provided for responses to the questions at the top of the spreadsheet. Column E asked whether, in the responding company’s opinion, the recommended practice is no longer applicable, perhaps because advances in technology have rendered it obsolete, or for any other reason. If this question was answered Yes, the respondent was not required to answer the remaining questions (in columns F through J) about that practice.

Column F asked for the company’s rating of the cost to implement a practice, relative to the other recommended practices. The choices were Very Low (VL), Low (L), Moderate (M), High (H), and Very High (VH). A Very Low rating suggested essentially no additional cost above the normal costs of doing business would be needed. A Very High rating suggested that major expenditures would be required.

Columns G, H, and I dealt with the company’s implementation of each practice. In Column G, the respondent was asked to indicate whether the company has implemented the practice fully (F), partially (P), or not at all (N). If they had not implemented the practice, they were asked to indicate in Column H whether the company was planning to implement the practice. If the company had implemented an alternate solution to the problem addressed by the recommended practice, they were to so indicate in Column I.

In Column J, only for those recommendations that had been implemented fully or partially, the respondent was asked to provide a rating of the effectiveness of the recommendation in enhancing network reliability and preventing or reducing outages. (In some instances, companies provided a rating even though they had not implemented the practice.) A scale of 1 to 5 was indicated, with the ratings to be interpreted as follows:

<b>Rating</b>	<b>Interpretation</b>
5	The practice is definitely effective in preventing or reducing outages based, for example, on quantifiable measurements and experience.
4	Based on intuitive opinions or anecdotal evidence, the practice is effective in preventing or reducing outages.
3	The practice is somewhat, or moderately, effective in preventing or reducing outages.
2	The practice is only slightly effective in preventing or reducing outages.
1	The recommendation is basically ineffective in preventing or reducing outages.

The respondent could enter 0 in Column J to indicate that the company did not know the effectiveness of the practice.

Copies of the service provider and supplier Part 3 forms are displayed in Appendix 2.

## 4.2 Data Collection Process

The NRC designated Bellcore as the central point for requesting, collecting, compiling, and aggregating data for all task groups. All data provided to Bellcore was protected under a non-disclosure agreement. The data were treated as proprietary information, and specific references to individual respondents were removed during the aggregation process.

The NRC was directed to obtain a view of all segments of the industry. The NRC asked all the largest companies in the industry to participate. The companies represented more than 90 percent of the subscribers in each industry segment. Each company was asked to identify a Single Point of Contact (SPOC). In total, 6 ICs, 12 LECs, 18 wireless companies (including the 10 largest), 9 CATV companies, 9 satellite (or Mobile Satellite) companies, 1 Competitive Access Provider (CAP), and 14 suppliers identified SPOCs. Only 3 companies who were asked to provide a SPOC declined. Bellcore sent all data requests to the SPOC in each company. The Best Practices data requests were sent only to ICs, LECs, the CAP and suppliers.

The questionnaires were sent to the SPOCs on April 12, 1995. (The companies that were late in identifying their SPOCs received their questionnaires immediately after they identified their SPOCs.) The original cutoff date for responses was April 30, 1995. However this date was extended to August 31, 1995, to include as many responses as possible. Two suppliers responded that they do not manufacture relevant products and thus could not complete the questionnaire.

The final tally of returned questionnaires was as follows:

Industry Segment	Number of Responses
LEC and CAP	13*
IC	5*
Supplier	10*
<b>Total</b>	<b>28</b>

The responses were aggregated and summarized by the seven focus areas in the Purple Book, as described further in Section 4.3. These results were then analyzed by the Best Practice Team. Results for the E9-1-1 focus area were also provided to the ECOMM Team for analysis.

During its analysis, the Best Practice Team decided that there were sufficient indications of alternate solutions (approximately 170 from 12 service providers) that it was obligated to investigate further. A follow-up data request was sent to these 12 service providers, asking them to describe their alternate solutions. Six of the companies responded to this request, and these companies accounted for 78 (43 percent) of the 170 alternate solutions. The team's treatment of these responses is described further in the following sections of this report. (The alternate solutions for E9-1-1 Best Practices were also forwarded to the ECOMM Team for analysis.)

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\*Two service providers and one supplier returned only Part I of the questionnaire, indicating that they did not have an active program for implementing the Best Practices.

In a few instances, a company indicated that their response to the original data request was incorrect, and that they did not have an alternate solution for a particular practice. These changes were made in the original input data and reflected in revisions to the aggregated and summarized information provided to the Best Practice Team. (The revised data is the basis for the results presented in this report.)

### 4.3 Data Aggregation and Analysis Process

For Parts 1 and 2 of the data requests, the data aggregation consisted of counting the Yes and No answers to the first seven questions of Part 1, and listing the text of answers to question 8 (How widely understood or known within your company are the Best Practices recommendations?) and Part 2 (case studies) with any references to specific companies removed. Results for service providers and suppliers were separated.

The Best Practice Team also requested weighted results for the LECs, where the answers to questions 1 to 7 in Part 1 were weighted by the numbers of access lines served by each LECs shown in the table below. The results were expressed as a weighted-percent-Yes for each question.

<b>Company</b>	<b>Access Lines*</b>
Ameritech	17,560,000
Bell Atlantic	18,645,000
BellSouth	20,127,546
Frontier (formerly Rochester)	931,650
GTE	17,072,715
Lincoln	254,928
NYNEX	16,129,747
Pacific Telesis Group	14,873,000
Southern New England Telephone	1,927,623
Southwestern Bell Telephone	13,015,638
Sprint (local)	6,130,388
U S WEST	13,843,127
<b>Total</b>	<b>140,511,362</b>

\* As of December 31, 1993

The above access line data was obtained from the USTA Publication entitled “The Top 150 Largest Telephone Companies Reporting to USTA, Including Holding Companies.”

For Part 3, the initial aggregation was a table with counts of the different answers for each question for each practice as well as summary counts for each of the seven focus areas and grand totals. The Best Practice Team found it useful to add several items to this initial table:

- Averages and medians for the cost and effectiveness ratings for each practice

- Composite counts in which Very Low (VL) and Low (L) cost ratings were combined into a “Low” count and High (H) and Very High (VH) made up a composite “High” count
- Similar composite counts combining the (1) and (2) effectiveness ratings into a composite “Low” count and combining (4) and (5) ratings into a “High” count
- Similar composite “Implemented” counts that combined the counts of Fully and Partially Implemented responses.

The table was also presented in two sorted forms: one in which the practices were sorted in order of decreasing average effectiveness rating within each of the seven focus areas, and another sorted by increasing average cost rating. The team also examined equivalent tables in which percentages of answers were substituted for the raw counts of answers.

During the BPT's analysis of these tables, it became evident that the simple counts and percentages for implementation could be misleading when there were also indications of obsolete or alternate solutions. A composite measure of implementation was constructed from the original data in which each company's responses on an individual practice were combined into one count in one of the following categories. In descending order of application, the categories are as follows:

<b>Category</b>	<b>Interpretation</b>
O	Obsolete - the response indicated that the company considered the practice to be obsolete and there was no indication of an alternate solution
A	Alternate - the company indicated an alternate solution, regardless of their responses on obsolete or extent of implementation
F	Fully implemented - the company responded (F) for implementation and did not indicate obsolete or alternate solution
P	Partially implemented - the company responded (P) for implementation and did not indicate obsolete or alternate solution
W	Will (Plan to) implement - The company responded (N) for implemented, (Y) for planning to implement, and did not indicate obsolete or alternate solution
N	Not implemented - The company responded (N) for implemented, either (N) or blank for planning to implement, and did not indicate obsolete or alternate solution

A table (Appendix 5) containing counts of the various answers for this implementation measure, together with composite percentages, means and medians for the cost and effectiveness ratings, sorted by decreasing average effectiveness rating, became the basis for the team's final analysis. The table was augmented with percentages “implemented” (i.e., assigned F or P in the scheme above), and “implemented or alternate solution” (i.e., assigned A, F, or P).

The final table presented in this report (Appendix 6) includes two LEC-weighted implementation measures based on the access line data shown previously. The first was the weighted percentage

of F or P implementation values for all 11 LECs who submitted Part 3 data. The second was the weighted percentage for those companies responding to questions for the individual practice. (In most cases, the two percentages are the same because all 11 companies answered most of the questions. Where they differed, the second percentage was higher because it was based on a “smaller denominator” representing the total access lines for only those companies that answered the question.)

The figures included in this report are based on the data in the table described above.

Various statistical methods were applied to the data, such as scatter diagrams, curve-fitting routines and correlation calculations between cost and effectiveness ratings and percent implemented, tests of significance of differences between average ratings for focus areas, etc. Although these methods sometimes suggested possible relationships in one or another focus area, there were no relationships found that applied to all focus areas. The conclusions described in the remainder of this report are based primarily on the Best Practice Team’s analysis of data in the basic table and figures described above.

## 5.0 Best Practice Team Study Results

The Best Practice Team Study Results are reported as follows:

- Data Questionnaire Part 1. Analysis on the awareness and process for tracking and implementing Best Practices.
- Data Questionnaire Part 2. Responses to the request for anecdotal information on any Best Practices that have proven to be especially effective in reducing or avoiding network outages.
- Data Questionnaire Part 3:
  - Analysis of overall implementation of Best Practices.
  - Analysis of implementation of individual Best Practices by focus group.
- Analysis of Alternate Solutions.
- Categorization of Best Practices.

### 5.1 Part 1 Data Questionnaire Awareness Analysis

**5.1.1** Data questionnaire Part 1 asked about how a company is managing the *process* for tracking and implementing the Best Practices. Following is a summary of Service Provider data. The exchange carrier service provider data was weighted based on total number of access lines served by responding companies. It was not possible to have a similar weighting for the ICs. The team agreed that the exchange carrier weighting would be of interest to end users and consumer groups who are concerned with the reliability of their local service.

	<u>Yes</u>	<u>No</u>	<u>LEC Weighted %</u>
1. Has an individual or organization been designated as “owner” of the Best Practices list?	12 (67%)	6	88.2
2. Have individuals and/or organizations been designated as accountable for implementation of Best Practices?	14 (82%)	3	97.8
3. Is implementation of Best Practices tracked/monitored?	11 (65%)	6	73.8
4. Has a form of measurement been established for:			
a. Determining percentage of Best Practices implemented?	8 (44%)	10	72.3
b. Assessing impact on network reliability of Best Practices implemented?	9 (50%)	9	59.8

	<u>Yes</u>	<u>No</u>	<u>LEC Weighted %</u>
c. Assessing impact on network reliability of Best Practices <u>not</u> implemented?	8 (44%)	10	59.2
5. Can you relate the impact of implemented Best Practices with quantifiable/measurable results?	8 (44%)	10	45.6
6. Do you have a plan for implementation of Best Practices?	12 (67%)	6	83.7
7. Do you have commitment/support to implement the plan?	12 (71%)	5	88.0

The BPT believes that these results indicate that service providers took seriously the recommendations of the NRC. 82 percent designated individuals or organizations accountable for implementation. 79 percent (65 percent of the total respondents) of those companies track and monitor implementation. 67 percent of the respondents have a plan for implementation.

In addition to planning and tracking implementation, more than 44 percent of the respondents measure, in some way, the impact of their implementation or non-implementation of Best Practices.

**5.1.2 Question 8:** How widely understood or known within your company are the Best Practices recommendations contained in *Network Reliability: A Report to the Nation*?

The following are the actual verbatim responses to Part 1, Question 8, by service providers:

*Beyond the numerous copies that have been distributed to "key" organizations, these recommendations have been used as a point of referral and a resource during Root Cause Analysis, Excellence Through Quality Team evaluation and designs of experiment and recently in weak spot reviews.*

*Implementation group - known and understood. Market units understanding is marginal.*

*High priority Best Practices have been translated into specific actions; those Best Practices and actions are well known and consistently reinforced. Execution is the challenge. Other Best Practice recommendations (especially those requiring vendor and/or industry actions) are well known by staff, but less well known and visible to the field personnel.*

*There is a general awareness of the Best Practices individually, if not collectively, as the term "Best Practices" is used. In other words, the recommended processes and procedures are known, but the term "Purple Book" may not be recognized by a technician.*

*Most of our Network people have some knowledge of NRC Best Practices.*

*Very aware. Teams were formed to review and develop action plans. The "practices" were used as a sanity check.*

*The Corporate Best Practices implementation committee for "Network Reliability: A Report to the Nation" has been kept at the middle and upper management level. We currently have practices in place that match most of the requirements of the Best Practices.*

*Because of the operational/technical nature of the Best Practices, the primary focus for the Practices is within the division that has responsibility for the operation and maintenance of the network rather than in the marketing organization. Within the operations division, each group responsible for a specific network technology has been involved in the review of the focus teams' technical papers. In addition, the Practices have been reviewed by all of the Division's business process management teams. These teams drive all of the operational processes in the Division by providing leadership, coordination and planning. These teams evaluated the Best Practices from a process perspective and reported back to the Senior Officer responsible for network reliability on whether the recommendation had already been implemented; what the plans were for those recommendations not already implemented; and, if a recommendation was not to be implemented, what the rationale was for that decision.*

*Not widely.*

*Not very well known. Some of the Best Practices procedures are being addressed through our company's decision to go for ISO9000 certification.*

*This report has been widely distributed, and all organizations have responded with their status of implementation.*

*The people involved in providing input for root cause analysis of outages are aware of the Best Practices recommendations.*

*No more than a handful of people. We have not undertaken an effort to review and/or implement the "Best Practices" on a formal basis. However, it should be noted that in compliance with FCC Reportable Outage requirements a review of our procedures versus "Best Practices" is undertaken when an FCC reportable incident occurs. This process has been in place since the FCC adopted a "Best Practice" review requirement in July 1994.*

*Not ordered. Not used.*

The BPT concluded that these responses indicate a high level of awareness of the NRC recommendations and the Purple Book. They also validate the effectiveness of the Purple Book and the NRC industry symposium as communication channels that provide focus to the telecommunications industry.

### 5.1.3 Supplier responses to Data Questionnaire Part 1:

	<u>Yes</u>	<u>No</u>
1. Has an individual or organization been designated as “owner” of the Best Practices list?	6	4
2. Have individuals and/or organizations been designated as accountable for implementation of Best Practices?	7	3
3. Is implementation of Best Practices tracked/monitored?	4	6
4. Has a form of measurement been established for the following:		
a. Determining percentage of Best Practices implemented?	1	9
b. Assessing impact on network reliability of Best Practices implemented?	2	8
c. Assessing impact on network reliability of Best Practices <u>not</u> implemented?	1	9
5. Can you relate the impact of implemented Best Practices with quantifiable/measurable results?	4	6
6. Do you have a plan for implementation of Best Practices?	8	2
7. Do you have commitment/support to implement the plan?	9	1

The BPT believes that these results indicate that suppliers took seriously the recommendations of the NRC. 70 percent designated individuals or organizations accountable for implementation. 57 percent (40 percent of the total respondents) of those companies track and monitor implementation. 80 percent of the respondents have a plan for implementation. One anomaly in the data was that 90 percent of the respondents were committed and had support to implement the plan that only 80 percent said they had.

The fact that these results are lower than for the service providers can be explained. The total number of service provider Best Practices was 169, and the total for suppliers was 29. Not all of the 29 would be applicable to all respondents because they are specific to network elements (e.g., STPs, switches, and DCS). This small number of Best Practices would not require much effort to track, monitor, and measure impact.

#### 5.1.4 Supplier Responses to Question 8

Question 8: How widely understood or known within your company are the Best Practices recommendations contained in *Network Reliability: A Report to the Nation*?

Following are verbatim responses to Part 1, Question 8, by Suppliers:

*The understanding of the Best Practices recommendations is confined to development and service organizations.*

*[Company] is new in this part of the industry. The Purple Book is on order and will be reviewed for appropriate implementation.*

*[Company] is in general agreement with the FCC NRC Best Practices recommendations — they make good business sense. Most have already been implemented, although not specifically in response to the NRC recommendations.*

*Due to participation in the Network Operations Forum (NOF) and the related IITP Subcommittee for Interoperability Testing, [company] has wide understanding of the Best Practice recommendations. Many Practices have been implemented in both hardware and software testing.*

*The recommendations were distributed to the stakeholder groups within the company for review and implementation. All of the recommendations have been basically implemented, without requiring single owner or Focus Team.*

*Numerous members of [company] participated in the creation of *Network Reliability: A Report to the Nation*. The report serves as a major reference source to our network reliability planning.*

*Not widely understood. [Company] has implemented Best Practices identified by a joint study with [a university]. We are starting a review process to understand where we are aligned with the NRC Best Practices.*

*Known within Marketing, Systems Engineering, and Quality Assurance. Marketing has worked in close cooperation with [a customer] to determine compliance to the Best Practices list. Action items have been identified and are tracked.*

*Not well known.*

*Within our company, the people who are responsible for system network/product reliability are aware of the Best Practices contained in subject report.*

The BPT concluded that these responses indicate a lower level of awareness than for service providers of the NRC recommendations and the Purple Book. This may indicate a need to develop a channel to target suppliers with future recommendations.

## **5.2 Part 2 Data Questionnaire Anecdotal Information**

The complete text of the responses to Part 2 is found in APPENDIX 3. The main focus of the Part 2 responses was in three areas: Contractor Awareness, Root Cause Analysis, and Telco Procedural Best Practices. In these areas, respondents were most impressed with the effectiveness of Best Practices implemented. One response attributed a 74 percent drop in cable intrusions, resulting from no notification, to implementation of a Contractor Awareness Program, recommended as a Best Practice by the Fiber Focus Group. All respondents indicated a reduction in reportable outages attributed to the implementation of cited Best Practices. *The BPT encourages companies to take advantage of this information sharing and to study APPENDIX 3. The BPT believes that this kind of information sharing is an important outgrowth of all NRC activities and sends a very important message to the general public and Government that, competing companies in the industry can and do share information in the pursuit of stable and reliable telecommunications networks and dependable service to the customer.*

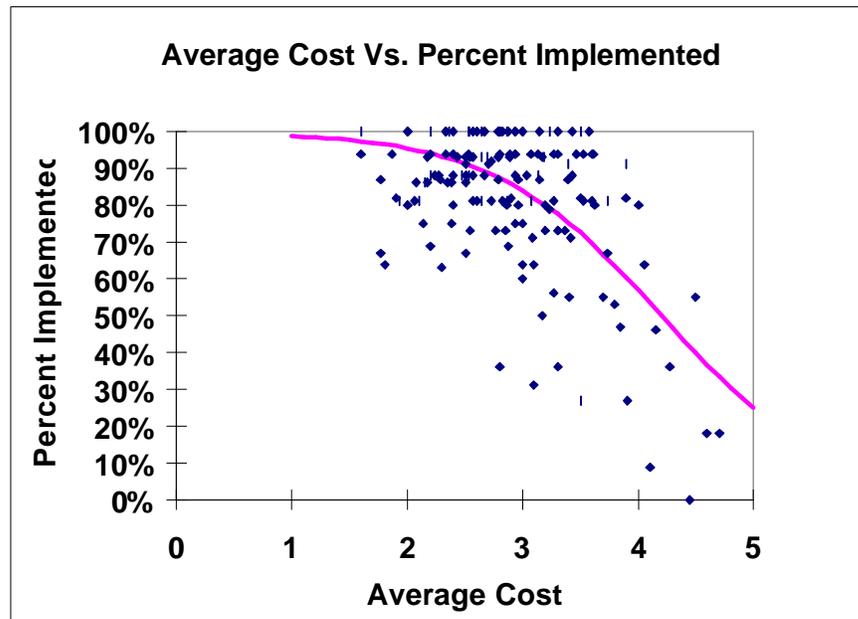
## **5.3 Part 3 Data Questionnaire Analysis Best Practices Implementation**

Service Provider implementation of Best Practices was developed from responses to Part 3 of the Data Questionnaire, which was a spreadsheet. The spreadsheet asked respondents to indicate a Full, Partial, Planned, or No Implementation for each of 169 Best Practices. A Partial response may indicate implementation of the full Best Practice (some BPs were composed of items that could be implemented on a stand-alone basis) in selected areas or locations, or partial implementation of the Best Practice throughout the company. Overall implementation, based on a Full or Partial response by 16 respondents on 169 Best Practices was 83 percent. This excludes the 32 responses indicating that implementation was planned. Out of a potential 2,704 responses (16 companies x 169 Best Practices), only 211 “No” responses were received.

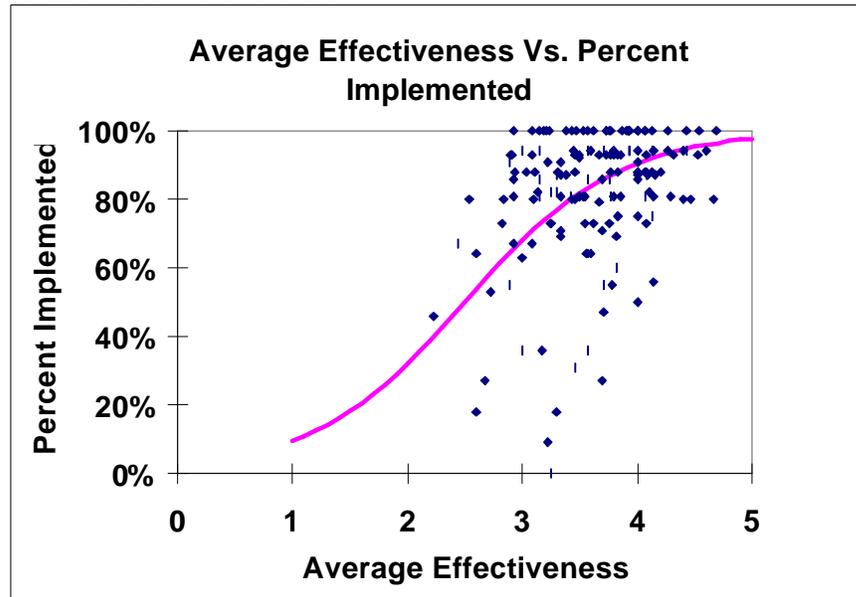
The questionnaire also asked respondents to evaluate the effectiveness and perceived cost to implement each Best Practice. As expected, there is a correlation between the percent implemented and the average cost rating (the correlation coefficient is -.50). The correlation can be seen in the overall trend of the data in the following scatter diagram. This means that there is a greater chance that a Best Practice will be implemented if the perceived cost to do so is not high. The curve on the chart is a fitted logistic model, which is commonly used for fitting models for probabilities or proportions that are constrained to lie between 0 and 1. The model has the form:

$$\text{Proportion implemented} = 1 / (1 + e^{-(A+B \times \text{Cost ratings})})$$

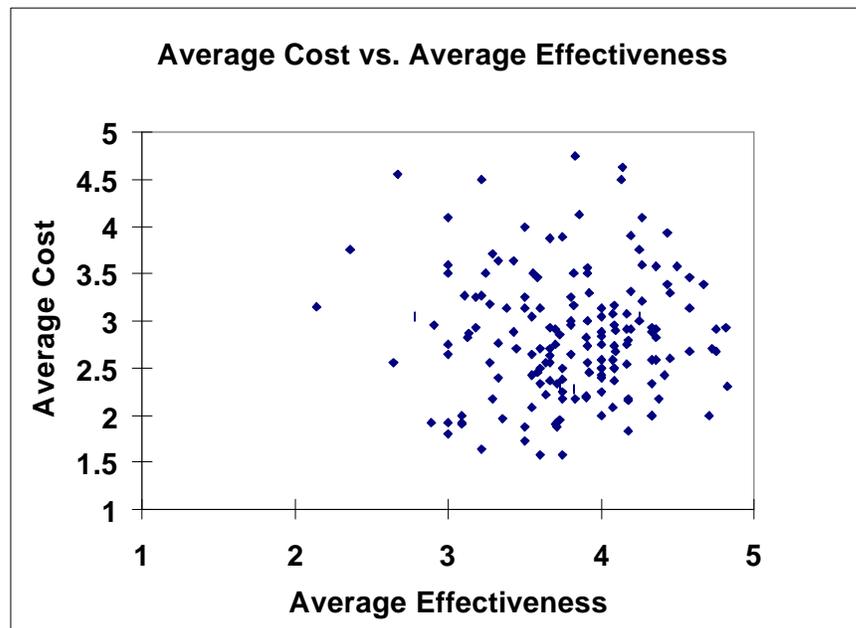
where A and B are selected to minimize the sum over all data points of the squared deviations between the actual proportion implemented and the model value. For this data set, A = 5.8 and B = -1.38. The fitted curve has a squared correlation coefficient of .34, meaning that it explains 34 percent of all the variation in the data.



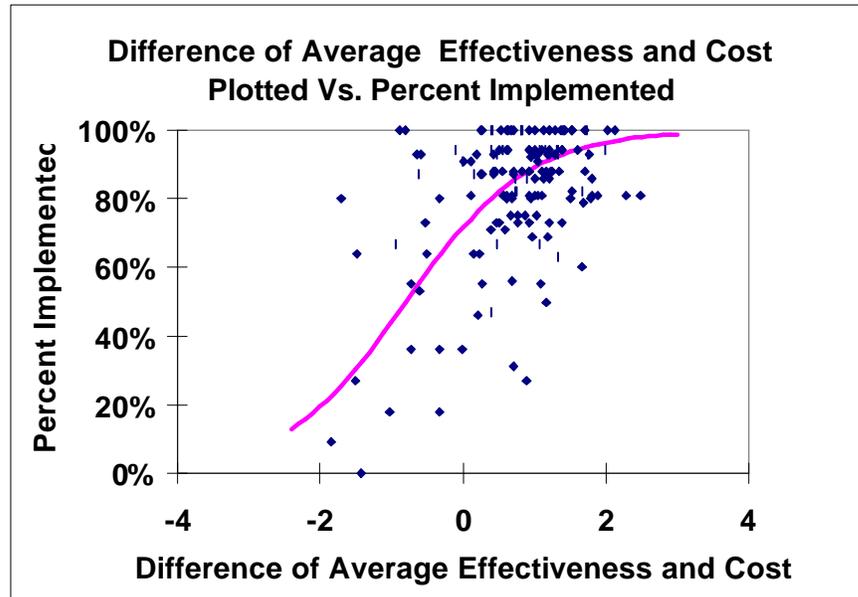
As also expected, there is a correlation between the percent implemented and the average effectiveness rating (the correlation coefficient is .53). Again, the correlation can be seen in the overall trend of the data in the following scatter diagram. This means that there is a greater chance that a Best Practice will be implemented if its perceived effectiveness is high. The curve on the chart is again a fitted logistic model, with  $A = -3.75$  and  $B = 1.50$ . The squared correlation coefficient is .30.



The perceived cost and the perceived effectiveness are uncorrelated. This means that the overall effectiveness rating of a best practice is unrelated to the cost of implementing that best practice. The attached graph shows the lack of any correlation between these two variables.

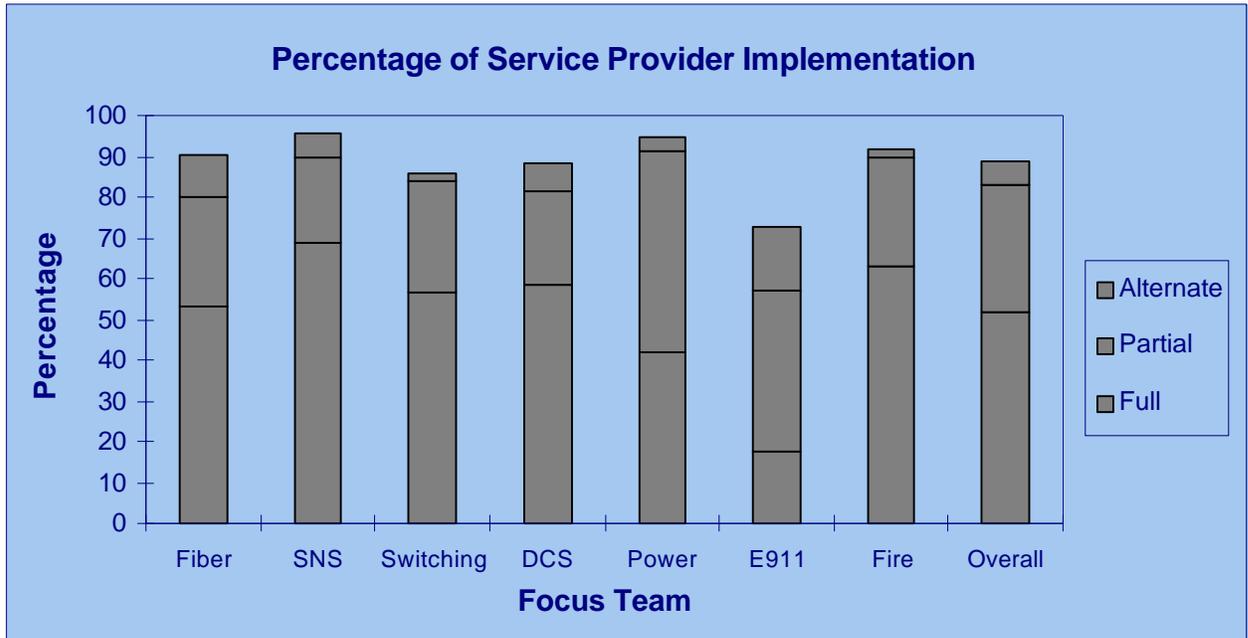


The difference between the average effectiveness rating and the average cost rating is strongly related to the percent implemented (the correlation coefficient is .675). This means that we can predict the percent implemented even better if we use the difference between the effectiveness rating and the cost rating than if we use either variable by itself. The correlation can be seen in the following scatter diagram. The curve on the chart is again a fitted logistic model, with  $A = .93$  and  $B = 1.18$ . The squared correlation coefficient is .58.



Although the data shows an overall relationship among implementation, perceived cost and effectiveness, implementation of individual Best Practices may or may not be tied to perceived cost or effectiveness. The BPT has identified examples of perceived high cost with both high and low levels of implementation. The BPT documented many perceived high cost to implement, highly effective Best Practices that have a high level of implementation in an attempt to show that the industry was willing to spend money and invest in Best Practices if they were perceived to be effective. This list is found in APPENDIX 4.

The following figure reflects the overall level of implementation by focus group.



The BPT cautions readers that because of limitations in the data, some expected conclusions may not be supported. The BPT has reviewed the ongoing FCC outage reports and NRSC Quarterly and Annual Reports in an attempt to

- Identify Best Practices cited as being effective or ineffective in preventing or mitigating outages.
- Correlate Best Practice implementation to Outage Trends.

What was found is that for some focus areas, the level of implementation is consistent with outage trends. However, improved outage trends may or may not be directly related to implementation of, or effectiveness of, Best Practices because our data does not indicate when they may have been implemented. Many Best Practices were implemented prior to or independent of the NRC recommendations.

#### 5.4 Part 3 Data Questionnaire Best Practice by Focus Group

The BPT analyzed the individual Best Practice response data by focus group. The following format was used for each focus group:

1. Develop conclusions and a summary of results based on totals for focus group and their ranking with other focus group totals
2. Rank results of effectiveness ratings high to low

3. Cite anomalies, unexpected results, winners, losers, alternative solutions and obsolete responses
4. Identify and analyze the “no” implementation responses
5. Categorize and classify Best Practices
6. Develop and document correlation to ongoing NRSC outage reports and trends.

Section 8, Exhibit 1 contains a spreadsheet listing individual Best Practices by focus group. The spreadsheet contains actual reference to the Purple Book section and paragraph and the average cost and effectiveness ratings for each Best Practice based on the actual data questionnaire responses. The Best Practices in this exhibit are ranked in order of average effectiveness high to low. Section 8, Exhibit 2 contains a chart for each focus group plotting implementation, average cost and effectiveness. The identification (ID) numbers used in these exhibits are different from the ID numbers used on the original data questionnaire. The numbering scheme was changed to reflect the focus group in the ID and to allow future additions to the list by focus group without renumbering all Best Practices. Section 8, Exhibit 3 contains a cross reference tool for those who need to relate the questionnaire to the results chart and spreadsheet.

Appendix 5 contains a list of Best Practices, by focus group, categorized and classified.

#### **5.4.1 Fiber Focus Group**

It was observed that the Fiber Focus Group Best Practices (FBxx) had the highest average cost to implement and the lowest effectiveness average of all the focus groups except E9-1-1 and that E9-1-1 was impacted by all of the other focus groups.

An analysis of individual Best Practices shows the following Best Practices as having been 100 percent fully or partially implemented

- FB04 - Respond to Locate Requests
- FB05 - Accurate Locates
- FB11 - Cooperation With Contractors
- FB12 - Training
- FB13 - Contractor Awareness.

FB09 - Technician Supervision, had high cost, high effectiveness but was implemented by 12 of 15 respondents.

The following Best Practices had alternate solution responses: FB01; FB02; FB06; FB07; FB08; FB09; FB10; FB15; FB17; FB18; FB19; FB20; FB21; FB22; FB23; FB24; FB25; FB26. FB15, Patrol Cable Routes, had five alternate solutions. Eleven alternate solution responses were found to be compliant with the original Best Practice. FB22, Stronger Conduit had the only valid alternate solution, which was burying conduit at a minimum depth of 48 inches in rodent-infested areas. Eleven responses were considered to be not in compliance with the original Best Practice.

Part II responses reflected very positive results with FB13, Contractor Awareness.

FB23, Separate Pole Lines, had the highest cost and lowest effectiveness ratings. This appears to be an outlier. It was also noted that the original recommendation was qualified by saying *only if cost justified*.

Appendix 5 indicates that 7 of 26 total Fiber Best Practices were shown to have limited application. As such, one would not expect 100 percent implementation of those seven.

The key recommendation of the original focus group concerned One Call Legislation. This was not considered to be a Best Practice for the BPT Questionnaire because it was not something implementable by service providers or suppliers. Although all service providers support the need for enforceable, uniform One Call Legislation, it has not become a reality. The Benchmarking Study recommended by the original focus group was completed prior to the formation of the Best Practice Team and also was part of our questionnaire and analysis.

Review of FCC outage reports and trends indicate that fiber dig-ups are still a major problem. This is consistent with the lower effectiveness ratings of the Fiber Focus Group Best Practices and the lack of national “One Call” legislation recommended by the original Fiber Focus Group.

#### **5.4.2 Signaling Network Systems (SNS) Focus Group**

The BPT observed that 13 of 15 Service Provider Best Practices (SNxx) were rated highly effective with a median of 4 or 5. The BPT also suggested that ranking the Best Practices by effectiveness ratings would not be useful because they are all rated high. It was agreed that there were two categories of Signaling Best Practices: process and architecture. The high number of process related Best Practices reflect the learning curve problem identified by the first NRC’s SNS Focus Group. One third (5 of 15) Service Provider Best Practices were 100 percent implemented. 100 percent of the Supplier Best Practices were implemented and were rated as highly effective.

Supplier SUP04, Minimize Initialization Duration, and Service Provider SN07, Maintain A Link Diversity, both were rated highly effective, high cost to implement with a high level of implementation. Service Provider SN13, Signaling Information Sharing, had less than 100 percent implementation and a low cost, medium effectiveness rating. *The BPT emphasizes the importance of this Best Practice, which has also been documented by the Network Operations Forum (NOF). Specifically, the NOF has published an Information Sharing Document as part of its NOF Reference Document.* This represents industry consensus on information sharing. The BPT has heard of examples of how information sharing has been observed and been effective. The Internetwork Interoperability Test Plan (IITP) Final Reports represent a perfect example of industry’s willingness to share sensitive information for the good of the industry and end user customers.

Service Provider SN14, Evaluate TIRKS™ Enhancements, was an outlier and probably should not have been put on the questionnaire because it is a product-specific Best Practice. All alternate solutions evaluated for this Best Practice were valid alternate

solutions that used systems other than TIRKS<sup>SM</sup>. The BPT recommends that the Best Practice be restated as follows: *Service Providers should develop and deploy a management system for use in circuit assignment, provisioning, and maintenance that will establish, monitor, track, and maintain link diversity.*

A review of FCC outage data indicates a significant downward trend in CCS outages. The high effectiveness ratings and implementation of signaling Best Practices are consistent with the improved outage performance.

There were nine IITP-related Best Practices in the original focus group report. These were not included in the data questionnaire because they were not implementable by individual suppliers or service providers. NRC Task Group II has recently completed an evaluation of IITP and developed a proposed funding/oversight process for IITP and IITP-like testing. IITP is proceeding and has been cited as contributing to the declining signaling outage trend. With two exceptions, the recommendations relate to continued commitment by the industry to IITP and the ongoing activities of IITP such as test script generation and information sharing. Although IITP continues, there have been schedule changes and test phase postponements attributed to lack of commitment by enough industry participants. One recommendation was to identify a focal point for testing efforts. This has been done with the designation of Bellcore as the overall coordinator and hub provider. The future assignment of this role will be according to the recommendations pending in Task Group II's final report. The following recommendations have not been implemented:

- The industry should establish a backbone network of dedicated transport facilities to accommodate post-mortem testing on demand without the lengthy start-up time involved in reestablishing a test network.
- The SNS recommends that equipment suppliers align schedules of new software releases.

Funding and business issues make it unlikely that these two recommendations will ever be fulfilled.

### **5.4.3 Switching Focus Group**

The BPT noted that there are a small number of Best Practices (SWxx) identified, possibly because switching represents a mature technology. All switching Best Practices had high effectiveness ratings. There are very few Alternative Solution responses, which also indicates a mature technology.

SW04, Establish Objectives for Number of Scheduled Outages, seems to be an anomaly because of the obsolete and alternative solution responses. Current objectives decline to zero scheduled outages by the year 2000. This would make this Best Practice obsolete. SW02, MOP for Hardware and Software Growth, had the highest effectiveness of all of the Focus Groups' Best Practices, had a low to medium cost to implement, yet had less than 100 percent implementation. 100 percent of the supplier Best Practices, with the exception of SUP08, Reduce the Need for Scheduled Outages, were implemented. One supplier had a "No" response for SUP08.

Switching-related FCC outage reports and trends are stable, which is consistent with the Best Practice effectiveness and implementation and the BPT statement that this is a mature technology.

#### **5.4.4 DCS Focus Group**

The BPT observed in the Service Provider results that DCS Best Practices (DXxx) had the highest number of *Planned* to implement responses, the highest number of Obsolete responses, and the highest number of Unknown effectiveness responses. The DCS Focus Group had the highest number of supplier Best Practices. Sixteen of a total of 19 Supplier Best Practices had 100 percent implementation, a 17th had a 1 partial and 1 planned response with the remainder being fully implemented. This would support the conclusion that DCS was a new technology at the time the NRC I recommendations were written and that it is still evolving.

*Best Practice DX13, Use Callback Modems, is no longer a Best Practice. Data responses include many obsoletes, the lowest implementation rate and the highest number of alternate solutions. The alternate solutions control remote access to the DCS via either private data networks, encryption techniques or centralized modem banks requiring a Secure ID.* Best Practice DX05, Validate Upgrades in Lab Environment, and DX22, Schedule System Backups, were both rated highly effective with relatively low cost to implement. Industry has recognized this with a high level of implementation. Low implementation of DX28, Institute DCS Technician Certification Programs, which is rated highly effective, may be because of implementation of DX18, Establish Centralized Support Organization, and vice versa. The two may accomplish the same objective. A majority of companies not implementing DX28 did implement DX18. For DX11, Develop Procedures for Manual Provisioning responses were unexpected in that they reflect high implementation for a low effectiveness rated Best Practice. This is most likely because it is a necessary process; however, because it is a manual process, it is perceived as being inefficient and ineffective.

The DCS-related FCC outage data does not indicate any real change from the baseline. However, the BPT believes that the Best Practices have had a tremendous positive impact on DCS outage performance. This is because the data has not been normalized to account for the dramatic growth in DCS deployment. We believe that given the increased number of DCS in service, one would expect an increase in DCS-related outages.

#### **5.4.5 Power Focus Group**

This focus group had the highest percentage of Best Practices (PWxx) with 100 percent implementation. There was high Partial Implementation because of many single stand-alone Best Practices incorporated into one Best Practice. Overall responses indicate these Best Practices are highly effective, high cost to implement with high implementation, especially compared to other focus areas.

PW13, Adhere to Established Best Practices for Installation/Removal Work, was rated highly effective with a low cost to implement. The BPT recommends that all companies implement this Best Practice. PW15, Put Standby Engines Online Before Power Fails in

Storms, was considered to have limited application and would only be useful in areas where there is sufficient advance notice of impending natural disasters. PW18, Automatic Reserve Lubrication Oil Systems, was deemed to have limited application. PW26, Diesel Portable Generators was also deemed to have limited application and would be dependent on the size and location of the site involved.

The number of power-related FCC Reportable Outages has increased compared to the Baseline Year. The impact of these outages, as based on the Committee T1 Technical Report 42 Outage Index, is lower than their impact in the Baseline Year. This may be consistent with the data that shows a high implementation of Best Practices in the mitigating category, as opposed to the preventing category.

#### **5.4.6 E9-1-1 Focus Group**

The BPT deferred individual Best Practice analysis to Task Group IV. The group, however, offers these general observations on the data.

- This group had the highest number of alternate solution responses
- This group had the highest number of responses for implementation
- This group had the lowest number of Best Practices with 100 percent implementation
- This group had the highest cost to implement average
- This group had the lowest effectiveness average
- All of the above supports the need for a separate Task Group, such as Task Group IV
- It would appear that cost may have had the greatest impact on implementation. However, the costs involved, for the most part, would be borne by the users and Government as opposed to the service providers who responded to the data questionnaire

Task Group IV has made the following recommendations related to Best Practices (ESxx):

- For Interoffice Facilities, implement the following:
  - ES01 - Diverse Interoffice Facilities
  - ES02 - Diverse Interoffice Transport Facilities With Standby Protection
  - ES03 - Diverse Interoffice Transport Facilities Using DCS
  - ES04 - Fiber Ring Topologies for 9-1-1 Circuits
- For PSAP Network, implement the following:
  - ES05 - Local Loop Diversity

- For PSAP to Media and PSAP to LEC Repair links, implement the following:
  - ES01 - Diverse Interoffice Facilities
  - ES05 - Local Loop Diversity
- Implement Best Practices providing alternate interoffice paths when primary facility fails:
  - ES06 - Alternate PSAPs from the E9-1-1 tandem switch
  - ES07 - Alternate PSAPs from the serving end office
  - ES09 - Wireless network as backup for E9-1-1 dedicated trunks
  - ES11 - Backup PSAP in the LEC's serving office
- *Eliminate ES27, Defer use of CCS Network Until Protocol Issues Are Addressed by Standards Bodies.*

#### **5.4.7 Fire Focus Group**

The BPT observed that, compared to other focus groups, this focus group's Best Practices (FRxx) had the lowest average cost to implement, highest implementation, and highest average for effectiveness.

FR06, Test All Pre-1989 VRLA Batteries had a relatively low implementation, which can be explained by its categorization as Limited Application. FR16, Prohibit Smoking in Buildings, and FR29, Restrict Use of Space Heaters, were both rated highly effective, low cost to implement, and high implementation. FR12, Implement a Certification and Training Program for Contractors, had some unexpected Not Implemented/Do Not Plan to Implement responses that need to be investigated. The BPT recommends that this Best Practice should be implemented. FR24, Administer Elevator Routines, and FR22, Verify Dumpster Location, were both identified as having limited application. FR33, Provide Automatic Notification of Local Fire Department, should be reevaluated because of different interpretations of implementation compliance by the BPT.

One valid alternate solution was identified for this focus group. Closed Halon gas suppression systems in all major facilities was considered as alternate solution for FR34, Implement Early Smoke Detection and Ventilation Systems. However, Halon negatively affects the Ozone Layer, and an alternate chemical has not been accepted.

The BPT could draw no conclusions from the review of FCC outage data because of the short time (August 1994) since the FCC has clarified the reporting rules on outages due to fires.

## 5.5 Analysis of Alternate Solutions

As reported in Section 4.2, there were 170 alternate solution responses. The BPT was very interested in determining what these alternate solutions were and sent a letter to all respondents asking them to describe their alternate solutions. Six companies responded to this request accounting for 78 of the 170 alternate solutions. This represents a 50 percent response rate covering 43 percent of the alternate solution responses. The BPT evaluated the responses and classified them as being in compliance with the original Best Practice, not as complying with the original Best Practice or as being a valid alternate solution. The E9-1-1 alternate solutions were referred to Task Group IV for evaluation. There were seven valid alternate solutions for three Best Practices: SN 14, Evaluate TIRKS<sup>SM</sup> Enhancements; DX13, Use Callback Modems; and FR34, Implement Early Smoke Detection and Appropriate Ventilation Systems. These solutions were addressed above in the individual focus group analyses. Other results are as follows:

- 14 of 42 service provider responses were found to be in compliance with the original Best Practice.
- 21 of 42 service provider responses were found to be noncompliant with the spirit of the original Best Practice and not valid alternate solutions.
- 3 of 3 supplier responses were found to be compliant with the original Best Practice.

*The BPT encourages companies to carefully evaluate the original Best Practices, focusing on the intent before deciding on an alternate solution.*

## 5.6 Categorization of Best Practices

As one of its original deliverables, the BPT set out to determine whether Best Practices were oriented toward preventing an outage occurrence or event or mitigating the impact of an outage occurrence or event on telecommunications service. As we started analysis of the individual Best Practices, some other categories became obvious and warranted our attention. For example, is the Best Practice internally or externally focused. “One Call” legislation is an example of an externally focused Best Practice in that individual companies could not implement on their own. Some Best Practices were not very specific and called for more of a philosophical approach by companies. As a result, the BPT decided to classify Best Practices by the following types: **Direction** — The Best Practice was at a level of specificity that could be characterized as recommending that a direction be taken by the service provider in improving its reliability; **Goal** — The Best Practice was at a level of specificity that could be characterized as recommending an overall goal be accomplished by the service provider to improve its reliability; and **Objective** — The Best Practice was at a level of specificity that could be characterized as recommending that a measurable objective be set by the service provider in improving its reliability. Another categorization that became obvious was, where does the Best Practice get implemented?

Is it process related, or does it require investment in facilities or a plant? The BPT-defined process as follows: the Best Practice would primarily impact the processes employed or actions taken by the service provider in providing or improving the reliability of service to customers (e.g., method, software, and testing). The BPT defined facilities or plant as follows: the Best Practice would primarily impact the network elements used by the service provider in providing or improving the reliability of service to its customers (e.g., buildings, equipment, and transmission media). It also became evident that some Best Practices were Universally applicable while others were Limited in application.

Appendix 6 contains a table classifying all service provider Best Practices according to the above categories. The BPT recommends that this be used as a tool for implementing decisions and analyzing and evaluating outages.

The table below summarizes the various categories and classifications. The following is the BPT’s explanation of the figures and assessment of implementation.

FOCUS TEAM	FIBER	SNS	SW	DCS	POWE R	FIRE	TOTA L
Prevent (P)	25	12	8	24	18	27	114
Mitigate (M)	1	3	0	8	8	7	27
Internal (I)	23	12	5	29	24	28	121
External (E)	3	3	3	3	2	6	20
Direction (D)	4	5	5	6	8	10	38
Goal (G)	19	10	2	26	14	24	95
Objective (O)	3	0	1	0	4	0	8
Process (P)	13	12	7	25	13	21	91
Facility/Plant (F)	13	3	1	7	13	13	50
Universal (U)	19	15	7	30	24	33	128
Limited (L)	7	0	1	2	2	1	13
TOTAL	26	15	8	32	26	34	141

- **Prevent-Mitigate.** Given that the thrust of the NRC was prevention of public telephone network outages, the majority of the Best Practices developed by the focus teams would be preventative rather than oriented toward impact mitigation.
- **Focus.** Given that external factors are more difficult to control, Best Practices that are externally focused would have a lower implementation rate.

- **Type.** Given that it is easier to conform to general guidelines rather than specific requirements, Best Practices that are less specific would be reported as having a higher rate of implementation.
- **Where.** Given that deployment of changes in physical network elements would involve a greater cost than process changes, Best Practices impacting facility/plant would have a lower implementation rate (assumes an inverse relationship between cost and implementation).
- **Applicability.** Given that it is easier to assess conformity to generally applicable guidelines, Best Practices that are considered to be obsolete or having limited applicability would have a lower implementation rate.

## 6.0 Conclusions and Recommendations

1. There is a high level of awareness and implementation of Purple Book Best Practices.
2. The Symposium and Purple Book were effective communication channels to the telecommunications industry.
3. Competing companies can share experiences with processes and procedures to the benefit of customers as a whole and new entrants to the industry.
4. Companies took seriously the NRC's recommendations.
5. Because of limitations in the data, some obvious conclusions may not be supported. For example, improved outage trends may or may not be directly related to implementation or effectiveness of Best Practices because the data does not indicate a time line of when they may have been implemented.
6. Analysis of Best Practice Sections of FCC Outage Reports indicate the implementation of Best Practices are valuable in preventing and mitigating outages but do not guarantee an outage will not occur.
7. 90 percent of identified Service Provider Best Practices were determined to still be universally applicable by the BPT, based on data and evaluation of Obsolete and Alternate Solution responses.
8. Only two Best Practices were found to be obsolete.
9. New Best Practices are emerging because of learning and technology changes.
10. Some alternative Best Practices are *not* best.
11. Industry, including new entrants, should implement (continue to), evaluate, internally track, and monitor implementation of NRC Best Practices as modified and categorized by the BPT.
12. Companies should use the Tools developed by the BPT for Best Practice implementation decision making, monitoring implementation, and outage reporting and analysis.
13. Industry should continue to use industry forums such as the NOF and NRSC and Standards organizations such as Committee T1 to introduce new Best Practices and propose changes to or obsolescence of existing Best Practices.
14. ATIS should assign responsibility for maintaining and updating the BPT-developed Tools.
15. The BPT encourages companies to take advantage of this information sharing and to study APPENDIX 3. The BPT believes that this kind of information sharing is an important outgrowth of all NRC activities and sends a very important message to the general public and Government that competing companies in the industry can and do

share information in the pursuit of stable and reliable telecommunications networks and dependable service to the customer.

16. The BPT emphasizes the importance of this Best Practice which has also been documented by the NOF. Specifically, the NOF has published an information sharing document as part of its NOF Reference Document.
17. The BPT recommends that SN14 be reworded as follows: Service Providers should develop and deploy a management system for use in circuit assignment, provisioning, and maintenance that will establish, monitor, track and maintain link diversity.
18. Best Practice DX13, Use Callback Modems, is no longer a Best Practice; it is obsolete.
19. Implementation of PW13, Adhere to Established Best Practices for Installation/Removal Work, is recommended.
20. ES27, Defer Use of CCS Network Until Protocol Issues Are Addressed, is obsolete.
21. Implementation of FR12, Implement a Certification and Training Program for Contractors, is recommended.
22. The BPT encourages companies to carefully evaluate the original Best Practices focusing on their intent before deciding on an alternate solution.

## **7.0 Acknowledgments**

The Best Practice Team gratefully acknowledges the encouragement, support, and direction we received from our mentor Frank Ianna. Without his support, it is unlikely that we would have been successful in meeting our objectives.

We also express our appreciation to Ray Albers, P.J. Aduskevicz, and Harold Daugherty for their prodding and support for our work.

Without the input of Ken Grace, of Bellcore, there would be no report. Ken's work on the questionnaire, data manipulation and analyses and development of Section 4 of this paper is gratefully acknowledged.

For hosting our many meetings we thank Arch McCain and BellSouth, Tim Mack and the staff at the Ameritech O'Hare Meeting Center, and Bill Klein and the staff at ATIS, who bore the brunt of our meeting schedule.

## 8.0 Exhibits

### **8.1 Best Practices Recommendations**

## Best Practices Recommendations

Ratings Scales are 1-Low to 5-High

ID	Focus Team	Recommendation	June 1993 Report Reference	Average Rating	
				Cost	Effectiveness
FB01	Fiber	Adherence to Procedures	A-6.1.3	2.17	4.18
FB02	Fiber	Warning Tape	A-6.1.3	2.54	2.92
FB03	Fiber	Visible Cable Marking	A-6.1.3	2.54	3.75
FB04	Fiber	Respond to Locate Requests	A-6.1.3	2.93	4.31
FB05	Fiber	Accurate Locates	A-6.1.3	2.79	4.54
FB06	Fiber	Enhanced Locating Equipment	A-6.1.3	3.23	3.75
FB07	Fiber	Use of Plant Route Maps	A-6.1.3	2.96	3.67
FB08	Fiber	Hand Dig in Safety Zone	A-6.1.3	2.79	4.46
FB09	Fiber	Technician Supervision	A-6.1.3	4.00	3.67
FB10	Fiber	On-Line Technical Support	A-6.1.3	3.19	2.54
FB11	Fiber	Cooperation With Contractors	A-6.1.3	2.57	4.08
FB12	Fiber	Training	A-6.1.3	3.00	3.92
FB13	Fiber	Contractor Awareness	A-6.1.3	3.14	3.77
FB14	Fiber	Contact With Land Owners	A-6.1.3	2.89	3.15
FB15	Fiber	Patrol Cable Routes	A-6.1.3	3.79	2.91
FB16	Fiber	Audits/Surveys of Plant	A-6.1.3	3.31	2.73
FB17	Fiber	Barriers	A-6.1.3	3.42	2.82
FB18	Fiber	Buried Cable	A-6.1.3	3.18	3.69
FB19	Fiber	Buried Facilities	A-6.1.3	3.39	3.77
FB20	Fiber	Shielding	A-6.1.3	2.96	3.38
FB21	Fiber	Protective Devices	A-6.1.3	3.19	3.33
FB22	Fiber	Stronger Conduit	A-6.1.3	3.73	3.10
FB23	Fiber	Separate Pole Lines	A-6.1.3	4.15	2.44
FB24	Fiber	No Visible Markings	A-6.1.3	1.77	2.23
FB25	Fiber	Secured Manholes	A-6.1.3	2.89	3.09
FB26	Fiber	Ventilate Manholes	A-6.1.3	3.85	2.90
SN01	Signaling	Awareness Training Program	B-5.2.4.5	2.67	3.71
SN02	Signaling	Architectural Alternatives	B-5.2.4.5	3.61	4.00
SN03	Signaling	Off-Peak Scheduling	B-5.2.4.5	2.53	4.27
SN04	Signaling	STP Maintenance Personnel Training	B-5.2.5.4	2.93	4.00
SN05	Signaling	Evaluation & Periodic Maintenance of SCP UPS	B-5.2.6.2	2.79	4.00
SN06	Signaling	Place SCPs in CO Environment	B-5.2.6.2	2.86	4.15
SN07	Signaling	Maintain A-Link Diversity	B-5.2.7.1.1, 6.2.1	3.47	4.67
SN08	Signaling	Review Rehome Procedures	B-5.2.8	2.36	4.14
SN09	Signaling	Review Detection & Manual Intervention Procedures	B-5.2.8	2.43	3.57

## Best Practices Recommendations

Ratings Scales are 1-Low to 5-High

ID	Focus Team	Recommendation	June 1993 Report Reference	Average Rating	
				Cost	Effectiveness
SN10	Signaling	Training in Trouble Detection & Isolation	B-5.2.8	2.50	3.79
SN11	Signaling	Training in Power Equipment Maintenance	B-5.2.8	2.53	3.73
SN12	Signaling	Failure Data Collection & Root Cause Analysis	B-6.1.1	2.40	3.73
SN13	Signaling	Signaling Information Sharing	B-6.1.2	2.27	3.47
SN14	Signaling	Evaluate TIRKS Enhancements	B-6.2.1.4	3.91	3.11
SN15	Signaling	Develop Crisis Management Exercises	B-6.2.2	2.87	3.69
SW01	Switch	Failure Data Collection & Root Cause Analysis	C-5.1.3, 5.2.3, 5.3.3	2.64	3.53
SW02	Switch	MOP for Hardware & Software Growth	C-5.1.3(3)	2.40	4.69
SW03	Switch	Establish Manual System Reinitialization Procedures	C-5.1.3(4)	1.93	3.31
SW04	Switch	Establish Objectives for Number of Scheduled Outages	C-5.2.3	2.88	3.33
SW05	Switch	Reduce Requirements Need for Scheduled Outages	C-5.2.3(5)	2.77	3.33
SW06	Switch	Coordinate Reinitializations & Improve Manual Procedures	C-5.2.3(6-7)	2.57	3.54
SW07	Switch	Implement New Requirements	C-5.5.3(3)	3.03	3.50
SW08	Switch	Negotiate Service Provider - Network Provider Reliability Agreements	C-5.5.3(4)	2.79	3.46
DX01	DCS	Institute DCS Awareness Program	D-6.1.1	2.60	3.83
DX02	DCS	Emulate Switching Environment for DCSs	D-6.1.1	2.57	3.85
DX03	DCS	Collaboration on Root Cause Analysis	D-6.1.1	2.20	4.08
DX04	DCS	Establish Core Team to Plan, Test and Evaluate Change Activities	D-6.1.2	3.07	4.00
DX05	DCS	Validate Upgrades in Lab Environment	D-6.1.2	2.93	4.29
DX06	DCS	Establish Standard Parameters & Office Settings	D-6.1.2	2.47	3.57
DX07	DCS	Validate New Procedures & Commands	D-6.1.2	2.67	4.00
DX08	DCS	Establish "Change Management" Group	D-6.1.2	2.83	4.07
DX09	DCS	Restrict Commands Available to Technicians	D-6.1.3	2.07	3.77
DX10	DCS	Ensure Facility & DCS Databases in Sync	D-6.1.3	2.93	3.50
DX11	DCS	Develop Procedures for Manual Provisioning	D-6.1.3	2.33	2.93
DX12	DCS	Initiate Procedures to Review Passwords	D-6.1.3	2.30	3.00
DX13	DCS	Use Callback Modems	D-6.1.3	3.10	3.00
DX14	DCS	Establish Procedure to Uninhibit Alarms after Provisioning	D-6.1.3	2.14	3.46
DX15	DCS	Provide Capacity to Process Alarms & Control the DCS	D-6.1.4	3.13	3.83
DX16	DCS	For Service Restoration, Provide Fully Redundant Communication Links	D-6.1.4	3.17	3.83
DX17	DCS	Eliminate Silent Failures	D-6.1.4, 6.1.8	2.89	4.00
DX18	DCS	Establish Centralized Support Organization	D-6.1.5	3.27	4.43
DX19	DCS	Establish Performance Levels	D-6.1.6	2.53	2.92
DX20	DCS	Establish Disaster Recovery Plans	D-6.1.7	2.73	3.77
DX21	DCS	Failure Data Collection & Root Cause Analysis	D-6.1.7,7	2.50	3.42

## Best Practices Recommendations

Ratings Scales are 1-Low to 5-High

ID	Focus Team	Recommendation	June 1993 Report Reference	Average Rating	
				Cost	Effectiveness
DX22	DCS	Schedule System Backups	D-6.1.8	2.40	4.21
DX23	DCS	Ensure Adequate Documentation	D-6.2.1, 6.2.2, 6.2.3	2.40	3.57
DX24	DCS	Document System Overview & Procedures	D-6.2.4	2.18	3.57
DX25	DCS	Develop Acceptance Testing Checkoff Sheet	D-6.2.4	2.10	4.08
DX26	DCS	Include Troubleshooting Flowcharts in Documentation	D-6.2.4	2.35	3.54
DX27	DCS	Use Human Factors Considerations in Documentation Development	D-6.2.5	2.15	3.15
DX28	DCS	Institute DCS Technician Certification Programs	D-6.2.11	3.27	4.00
DX29	DCS	Have Sufficient Spares	D-6.4.1(b)	3.27	4.14
DX30	DCS	Deploy Systems with Redundant Disk Drives	D-6.4.1(c)	3.47	4.14
DX31	DCS	Insist on Suppliers Providing Reliability Data to Prove Designs Meet Network Criteria	D-6.4.2(b)	2.23	3.15
DX32	DCS	Revisit Reliability Requirements & Reallocate Failure Rates	D-6.5.1, 6.5.2	2.50	3.04
DX33	DCS	Revisit DCS Sizing	D-6.5.4	2.38	2.92
PW01	Power	Increase Emphasis on Operational Factors	E-1	3.07	4.13
PW02	Power	Eliminate Single Points of Failure	E-6(2)	3.57	4.60
PW03	Power	Adhere to Standards	E-6(3)	2.82	3.93
PW04	Power	Coordinate with Electric Utilities	E-6.1, 6.13.2(4)	2.00	3.43
PW05	Power	Adhere to Established Best Practices for Commercial Power	E-6.1.9	2.53	3.21
PW06	Power	Adhere to Established Best Practices for Standby Generators	E-6.2.2	3.30	3.93
PW07	Power	Adhere to Established Best Practices for Building AC Systems	E-6.3.1	3.43	3.93
PW08	Power	Adhere to Established Best Practices for DC Plants	E-6.4.1	3.50	4.13
PW09	Power	Adhere to Established Best Practices for DC Distribution Systems	E-6.4.1	3.30	3.73
PW10	Power	Adhere to Established Best Practices for Alarms & Remote Monitoring	E-6.6.4	3.43	4.43
PW11	Power	Employ Specialized Teams	E-6.7	3.53	3.93
PW12	Power	Adhere to Established Best Practices for Operations & Maintenance	E-6.7.1	3.00	4.40
PW13	Power	Adhere to Established Best Practices for Installation/Removal Work	E-6.8.2	2.67	4.27
PW14	Power	Maintain & Exercise Site-Specific Procedures	E-6.9	2.53	4.07
PW15	Power	Put Standby Engines Online Before Power Fails in Storms	E-6.13.1(1)	2.20	3.91
PW16	Power	Design Standby Systems for Wind and Rain in Coastal Areas	E-6.13.1(2)	2.69	3.82
PW17	Power	Improve Fuel Systems Reliability: Design & Maintenance	E-6.13.1(3)	2.67	3.86
PW18	Power	Automatic Reserve Lubrication Oil Makeup Systems	E-6.13.1(4)	3.00	3.18
PW19	Power	Automatic AC Transfer Switches Instead of Paired Circuit Breakers	E-6.13.1(5)	3.15	3.82
PW20	Power	Local Procedures and Contingency Plans for Power Emergencies	E-6.13.1(6)	2.33	4.00
PW21	Power	AC Tap Boxes Outside COs for Portable Engines	E-6.13.1(7)	3.73	4.00
PW22	Power	Remote Power Monitors	E-6.13.1(8)	3.53	3.79
PW23	Power	Power Expertise/Power Teams	E-6.13.1(9)	3.13	4.07

## Best Practices Recommendations

Ratings Scales are 1-Low to 5-High

ID	Focus Team	Recommendation	June 1993 Report Reference	Average Rating	
				Cost	Effectiveness
PW24	Power	Fewer but Larger DLC RTs with Bulk Power	E-6.13.2(1)	3.36	3.45
PW25	Power	Security of Portable Generators	E-6.13.2(2)	2.64	3.25
PW26	Power	Diesel Portable Generators	E-6.13.2(3)	3.62	3.09
ES01	E911	50% of 911 Circuits Provisioned on Each of Two Diverse Interoffice Facilities	F-6.1.1, Fig. 6-2	3.39	4.40
ES02	E911	Automatic Switching of 911 Circuits to a Diverse Standby Protection Facility	F-6.1.1	3.40	4.00
ES03	E911	Diverse Interoffice Facilities from Customer End Office Home onto Two Diverse DCSs	F-6.1.1, Fig. 6-3	3.70	3.71
ES04	E911	Fiber Ring Topologies for 911 Circuits	F-6.1.1.1, Fig. 6-4	4.50	3.78
ES05	E911	Red-tagged, Diverse Equipment within a Central Office	F-6.1.4	1.80	2.89
ES06	E911	Alternate PSAPs off the 911 Tandem Switch	F-6.1.3.1, Fig. 6-7	3.30	3.56
ES07	E911	Alternate PSAPs off the End Office	F-6.1.3.1, Fig. 6-7	3.10	3.25
ES08	E911	Public Switched Network as Back-up for 911 Dedicated Trunks	F-6.1.3.3, Fig. 6-9	2.80	3.57
ES09	E911	Cellular Network as Back-up	F-6.1.3.4, Fig. 6-10	3.50	3.00
ES10	E911	Intraoffice Call Termination to Mobile PSAP when Office is Isolated	F-6.1.3.5, Fig.6-11	3.00	2.67
ES11	E911	Back-up PSAP Permanently Located Within the Central Office	F-6.1.3.5	4.10	2.60
ES12	E911	Two 911 Tandems to Serve a Single Customer and the PSAP	F-6.1.2.1, 6.2.1, Fig. 6-5	4.70	3.22
ES13	E911	Re-homing to Back-up 911 Tandem Switch	F-6.1.2.2, 6.2.2, Fig. 6-6	4.45	2.60
ES14	E911	Diverse Paired 911 Tandem Switches	F-6.2.1	4.27	3.25
ES15	E911	Multiple Diverse 911 Tandem Switches with Paired Diverse DCSs	F-6.2.2, Fig. 6-6	4.60	3.17
ES16	E911	Operator Services Tandem as Backup for 911	F-6.1.3.2, Fig. 6-8	3.30	3.29
ES17	E911	Evaluate Trend toward Increased Concentration of 911 Capabilities	F-1.3, 6.2	3.89	3.57
ES18	E911	Local Loop Diversity for Larger PSAPs	F-6.3	4.05	3.33
ES19	E911	911 Network Management Center & Procedures to Manage and Prioritize Repairs	F-6.4	3.50	3.60
ES20	E911	Diverse ALI Database Systems	F-6.5, Fig. 6-14	3.89	4.11
ES21	E911	Move Mass Calling Stimulator Away from 911 Tandem Switch	F-6.6, Fig. 6-15	2.40	3.14
ES22	E911	Pre-planning and Cooperation to Minimize Effects of Mass Calling Events	F-6.6	1.90	3.43
ES23	E911	Contingency Plan Development for Emergency 911 Service	F-6.7.1	2.70	3.30
ES24	E911	Contingency Plan Training for Emergency 911 Service	F-6.7.1	2.50	3.22
ES25	E911	Public Education on Proper Use of 911 Service	F-6.7.1	2.90	2.89
ES26	E911	Improve Communications Among LECs, Administrators & Public Safety Agencies	F-1.3	2.20	3.25
ES27	E911	Defer Use of CCS Network Until Protocol Issues Addressed by Standards Bodies	F-1.3, 6.7	-	-
ES28	ECOMM	Redundancy/Diversity of Links from PSAP to Emergency Response Personnel	ECOMM Report 6.12		
ES29	ECOMM	Redundancy/Diversity of Links to Media and Network Repair Centers	ECOMM Report 6.13		
ES30	ECOMM	Private Switch/Alternative LEC ALI	ECOMM Report 6.14		
ES31	ECOMM	Commercial Mobile Radio Services Should Use 911 as Emergency Access Code	ECOMM Report 6.15		
ES31	ECOMM	Cable Television Providers Should Use NCTA Recommended Practices	ECOMM Report 6.16		

## Best Practices Recommendations

Ratings Scales are 1-Low to 5-High

ID	Focus Team	Recommendation	June 1993 Report Reference	Average Rating	
				Cost	Effectiveness
ES33	ECOMM	Uniform Method of Reporting and Tracking Significant Service Outages	ECOMM Report 6.17		
FR01	Fire	Develop Pre-plans with Fire Agencies	G-6.2.1	1.87	3.53
FR02	Fire	Verify Smoke/Heat Detection Capability	G-6.2.2	2.60	4.13
FR03	Fire	Meet NEBS Requirements for Power & Communication Cables	G-6.2.3A	2.93	3.93
FR04	Fire	Consider Non-reuse of Noncompliant Cable	G-6.2.3B	2.79	3.38
FR05	Fire	Use ANSI T1.311-1991 for COs	G-6.2.4	2.73	4.09
FR06	Fire	Test All Pre-1989 VRLA Batteries	G-6.2.5C	3.08	3.50
FR07	Fire	Establish Case History File by Equipment Category for Rectifiers	G-6.2.7A	2.38	3.33
FR08	Fire	Locate Transformers External to Buildings	G-6.2.9	3.17	3.75
FR09	Fire	Regularly Inspect Motors	G-6.2.10	2.50	3.50
FR10	Fire	Exercise & Calibrate Circuit Breakers	G-6.2.11	3.00	3.46
FR11	Fire	Use Defined Procedure for Cable Mining	G-6.3.1	2.08	3.83
FR12	Fire	Implement a Certification & Training Program for Contractors	G-6.3.2	2.93	3.69
FR13	Fire	Develop & Execute a Standard MOP for Vendor Work	G-6.3.3	2.20	4.00
FR14	Fire	Develop Site Management & Building Certification Program	G-6.4.1, 6.6.1, 6.7.1	2.86	3.71
FR15	Fire	Review Practices on Use of Soldering Irons	G-6.4.2	1.77	3.15
FR16	Fire	Prohibit Smoking in Buildings	G-6.4.3	1.60	4.08
FR17	Fire	Verify Aerial Powerlines are Not in Conflict with Hazards	G-6.5.1	2.85	3.09
FR18	Fire	Provide AC Surge Protection	G-6.5.2	3.23	3.62
FR19	Fire	Verify Grounding Arrangements	G-6.5.3	2.86	4.07
FR20	Fire	Assure Programs Exist for Alarm Testing	G-6.5.4	2.00	4.13
FR21	Fire	Avoid Use of Combustible Landscape Material	G-6.6.2	2.00	2.92
FR22	Fire	Verify Dumpster Location	G-6.6.3	2.00	2.83
FR23	Fire	Insure Proper Air Filtration	G-6.6.4	2.79	3.46
FR24	Fire	Administer Elevator Routines	G-6.7.2	2.29	3.23
FR25	Fire	Verify Elevator Building Compartments Comply with Code	G-6.7.3	2.50	3.30
FR26	Fire	Provide Smoke Detection and Ventilation in Motor Room	G-6.7.4	2.87	3.57
FR27	Fire	Use Over-current Protection Devices and Fusing	G-6.7.5	2.80	3.93
FR28	Fire	Inspect and Maintain HVAC areas	G-6.7.6	2.33	3.87
FR29	Fire	Restrict Use of Space Heaters	G-6.7.7	1.60	3.62
FR30	Fire	Establish Building Equipment Maintenance Program	G-6.7.8	2.80	3.60
FR31	Fire	Certified Inspection of Boilers & Fuel Storage Units	G-6.7.9	2.57	3.79
FR32	Fire	Provide All Critical Facilities with a Modern Smoke Detection System	G-8	3.60	4.53
FR33	Fire	Provide Automatic Notification of Local Fire Department	G-9	2.64	3.93
FR34	Fire	Implement Early Smoke Detection and Appropriate Ventilation Systems	G-10	3.60	4.14

## Best Practices Recommendations

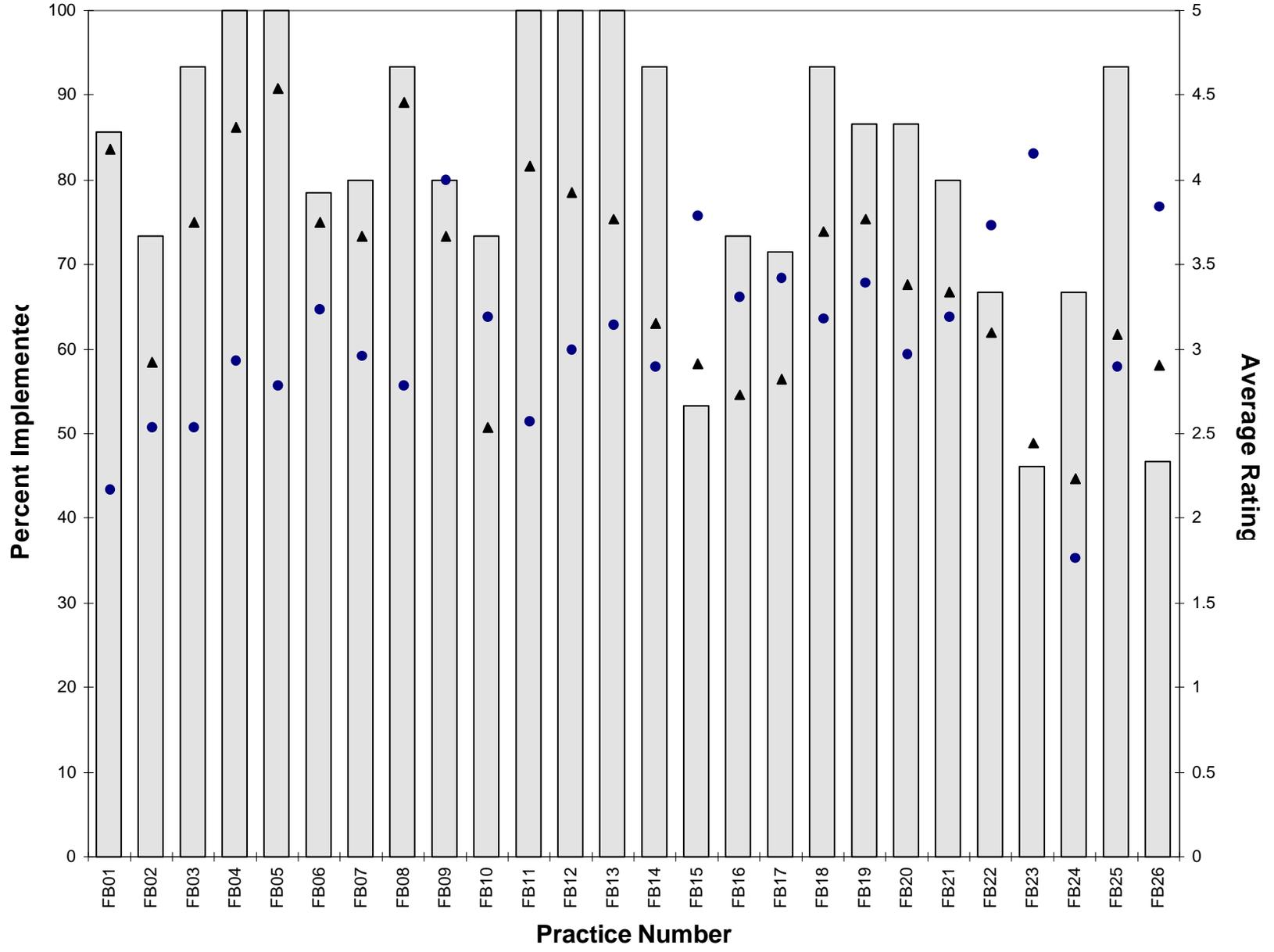
Ratings Scales are 1-Low to 5-High

ID	Focus Team	Recommendation	June 1993 Report Reference	Average Rating	
				Cost	Effectiveness
SUP01	Signaling	Software Fault Insertion	B-5.2.4.5, 5.2.5.4.	2.67	3.80
SUP02	Signaling	Hardware Fault Insertion	B-5.2.4.5, 5.2.5.4.	2.67	3.80
SUP03	Signaling	Review of Fault Recovery Actions	B-5.2.4.5, 5.2.5.4.	2.67	3.60
SUP04	Signaling	Minimize Initialization Durations	B-5.2.4.5, 5.2.5.4.	3.50	4.60
SUP05	Signaling	Place Added Emphasis on Human Factors Design	B-5.2.7.1.1	2.50	3.67
SUP06	Signaling	Failure Data Collect. & Root Cause Analysis	B-6.1.1	2.33	4.20
SUP07	Switch	Enhance System Defensiveness to Service Affecting Activity	C-5.1.3	3.83	4.00
SUP08	Switch	Reduce Need for Scheduled Outages	C-5.2.3(1-4)	3.50	4.40
SUP09	Switch	Hardware & Software Fault Recovery Design Convergence	C-5.3.3(5-6))	3.60	3.25
SUP10	Switch	Enhance Software Development Methodology	C-5.4.3(1-10)	3.83	3.60
SUP11	DCS	Collaboration on Root Cause Analysis	D-6.1.1	3.25	4.50
SUP12	DCS	Establish Core Team to Plan, Test and Evaluate Change Activities	D-6.1.2	3.50	4.50
SUP13	DCS	Validate Upgrades in Lab Environment	D-6.1.2	3.75	4.63
SUP14	DCS	Eliminate Silent Failures	D-6.1.4, 6.1.8	3.75	4.00
SUP15	DCS	Establish Performance Levels	D-6.1.6	3.50	3.75
SUP16	DCS	Ensure Adequate Documentation	D-6.2.1, 6.2.2, 6.2.3	4.00	3.67
SUP17	DCS	Establish Change Control Database	D-6.2.3	3.50	3.50
SUP18	DCS	Document System Overview & Procedures	D-6.2.4	2.75	3.50
SUP19	DCS	Develop Acceptance Testing Checkoff Sheet	D-6.2.4	2.50	4.00
SUP20	DCS	Include Troubleshooting Flowcharts in Documentation	D-6.2.4	4.00	4.13
SUP21	DCS	Use Human Factors Considerations in Documentation Development	D-6.2.5	3.50	4.00
SUP22	DCS	Develop Training for Customer Needs with Customer Testing	D-6.2.7	3.00	4.13
SUP23	DCS	Update Training as Product Evolves	D-6.2.8	3.25	4.13
SUP24	DCS	Develop Training for Local & Centralized Tier 1/ 2 OAM&P Personnel	D-6.2.9, 6.2.10	3.50	3.63
SUP25	DCS	Improve Software Process	D-6.3	4.50	4.75
SUP26	DCS	Review Level of Inspection on Critical Components	D-6.4.1(a)	3.25	3.75
SUP27	DCS	Deploy Systems with Redundant Disk Drives	D-6.4.1(c)	3.75	4.50
SUP28	DCS	Improve Documentation on Backup & Recovery	D-6.4.1(d)	2.75	4.13
SUP29	DCS	Develop Redundant Controller Architecture	D-6.4.2(a)	4.25	4.38

## 8.0 Exhibits

### **8.2 Focus Team Percent Implementation**

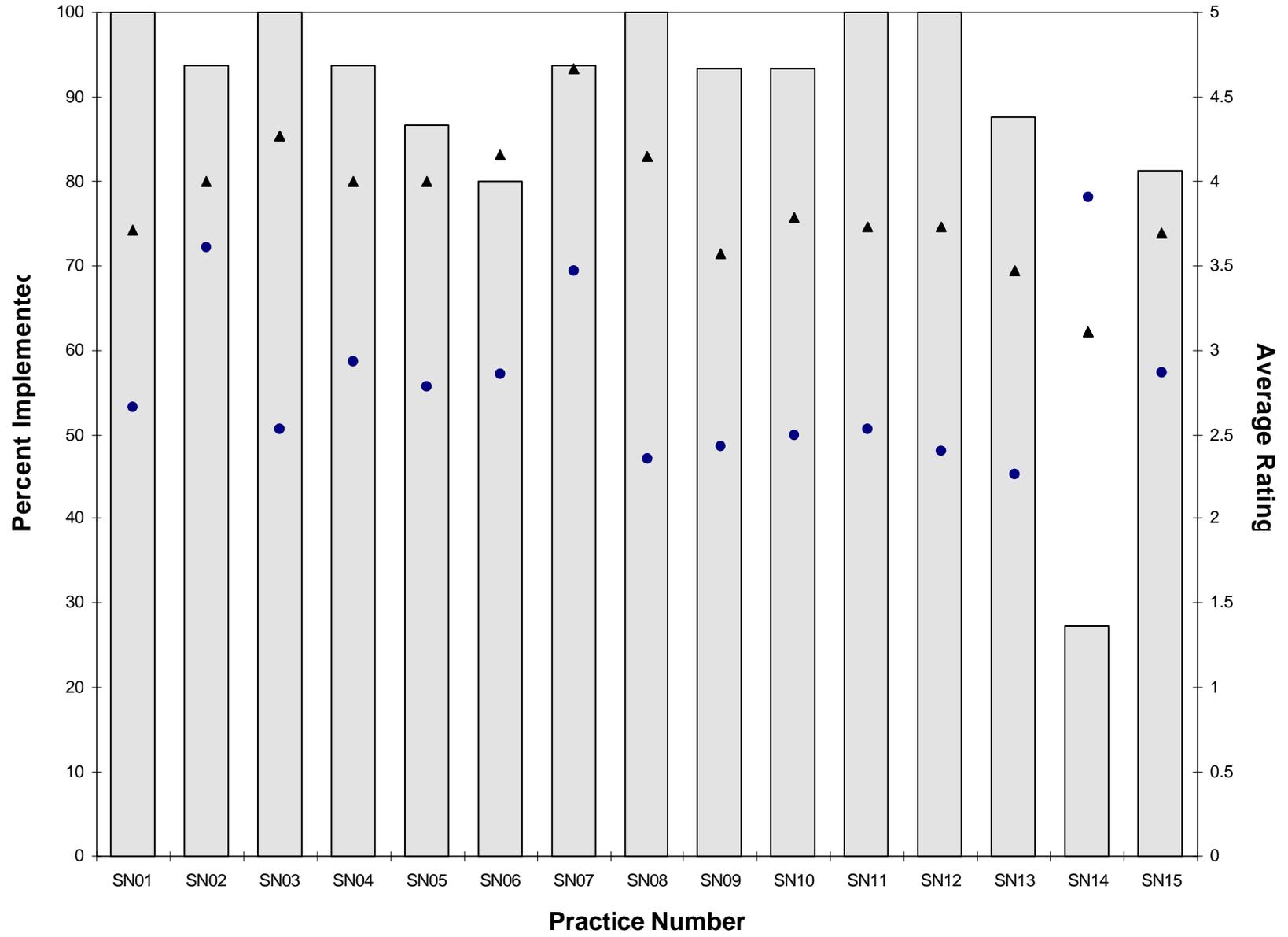
### Fiber Focus Team



□ Implementation ▲ Effectiveness ● Cost

Ratings: 5 - Very High to 1 - Very Low

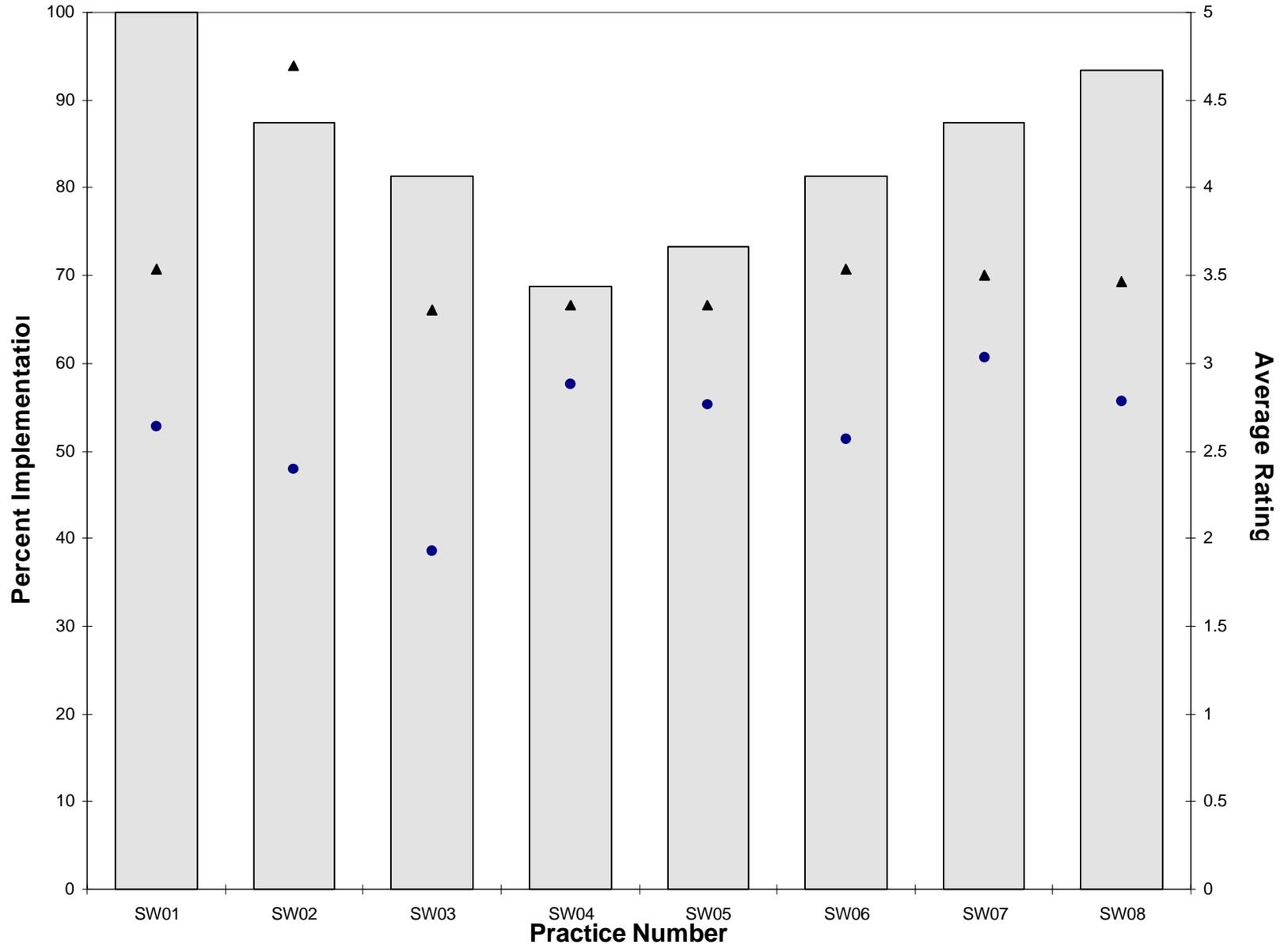
### SNS Focus Team



□ Implementation ▲ Effectiveness ● Cost

Ratings: 5 - Very High to 1 - Very Low

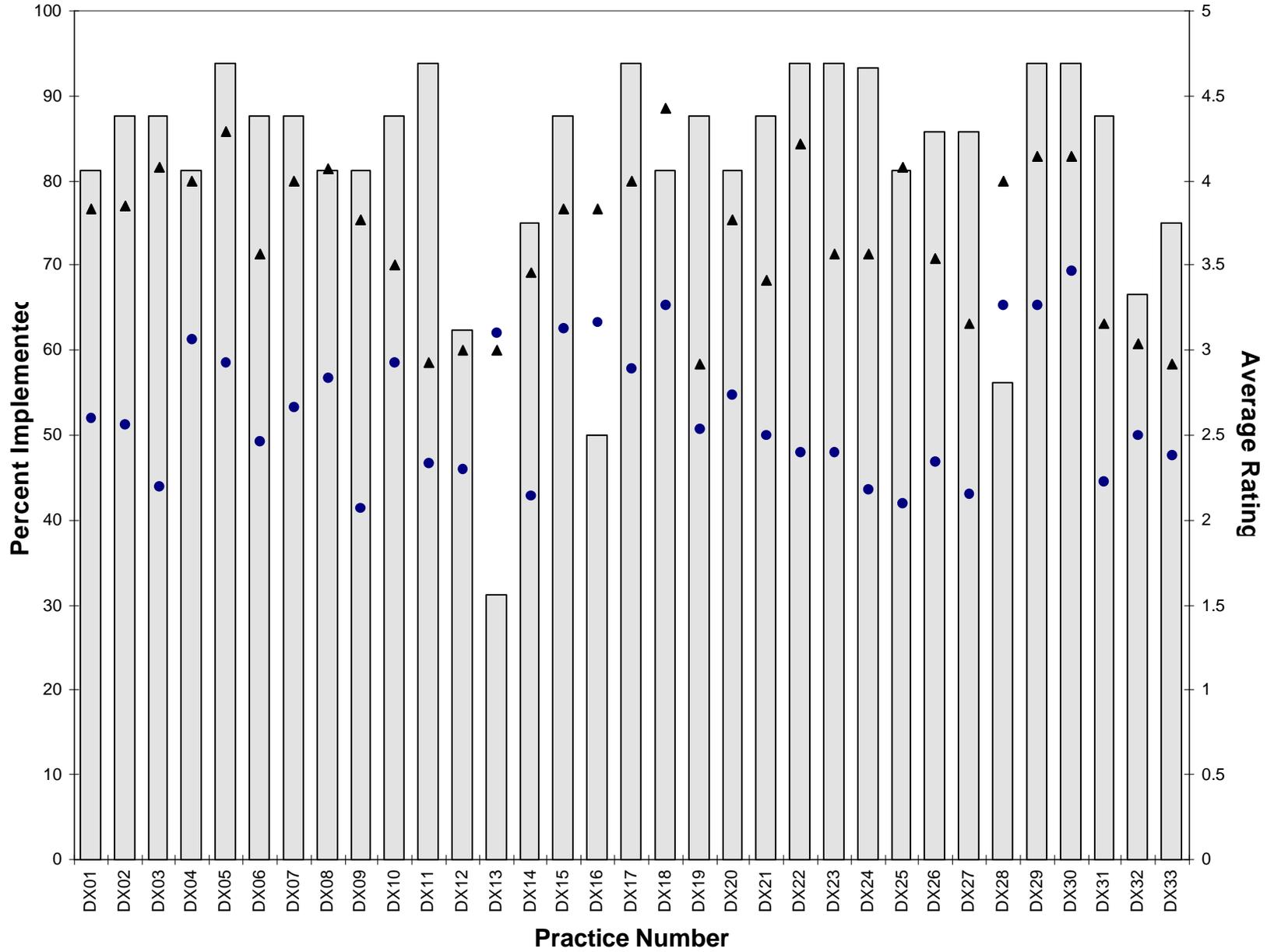
### Switching Focus Team



□ Implementation ▲ Effectiveness ● Cost

Ratings: 5 - Very High to 1 - Very Low

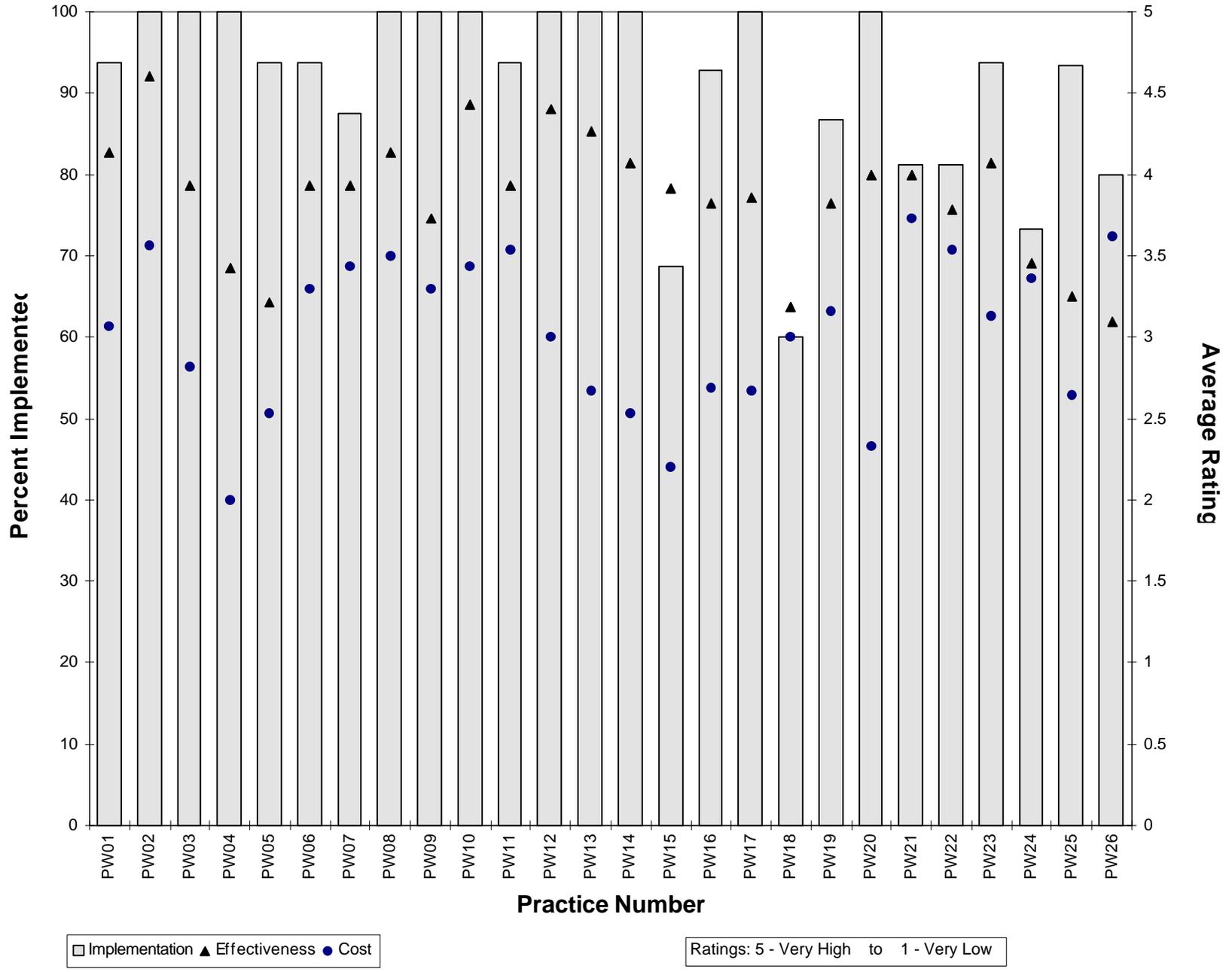
### DCS Focus Team



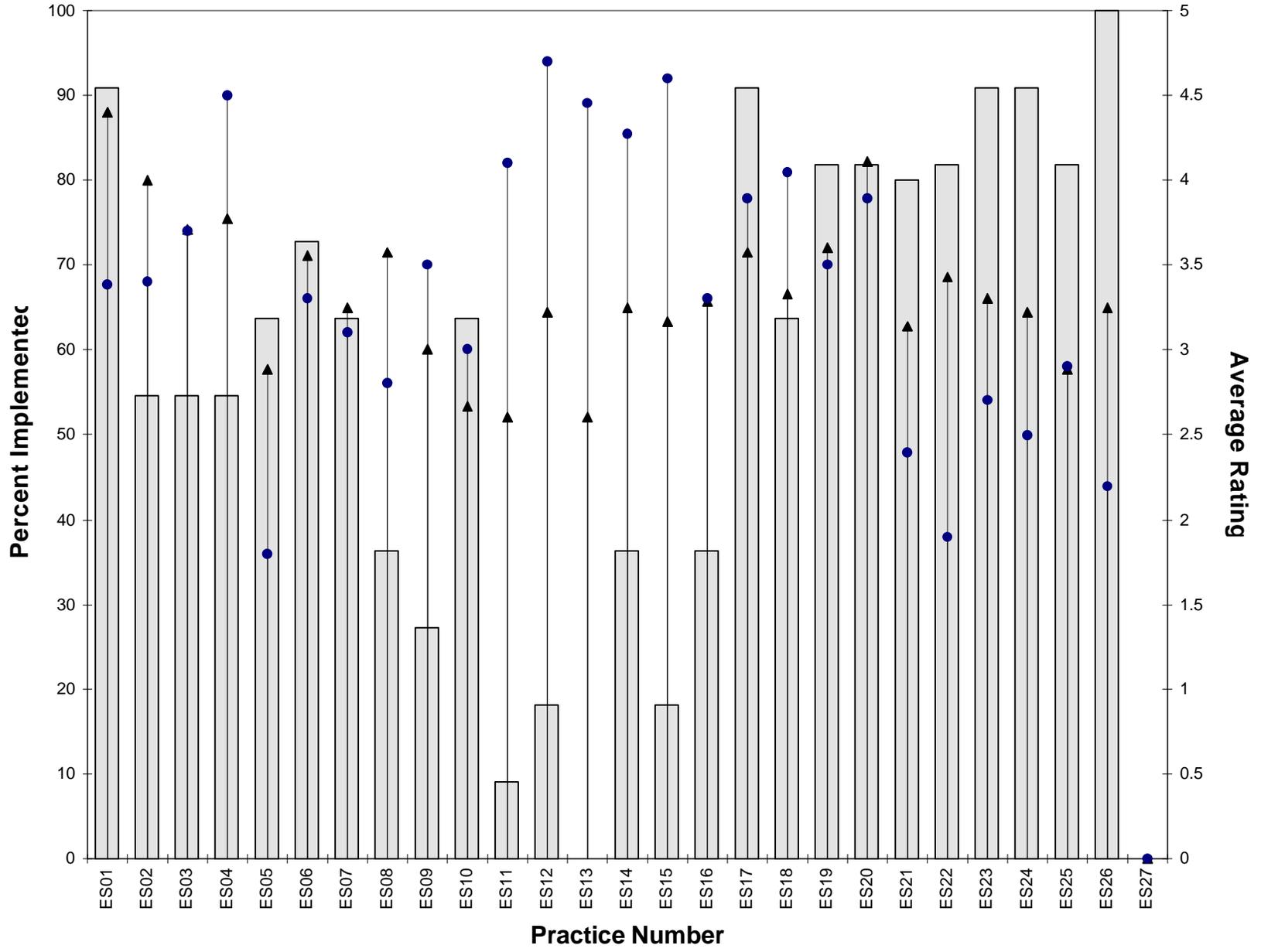
□ Implementation ▲ Effectiveness ● Cost

Ratings: 5 - Very High to 1 - Very Low

### Power Focus Team



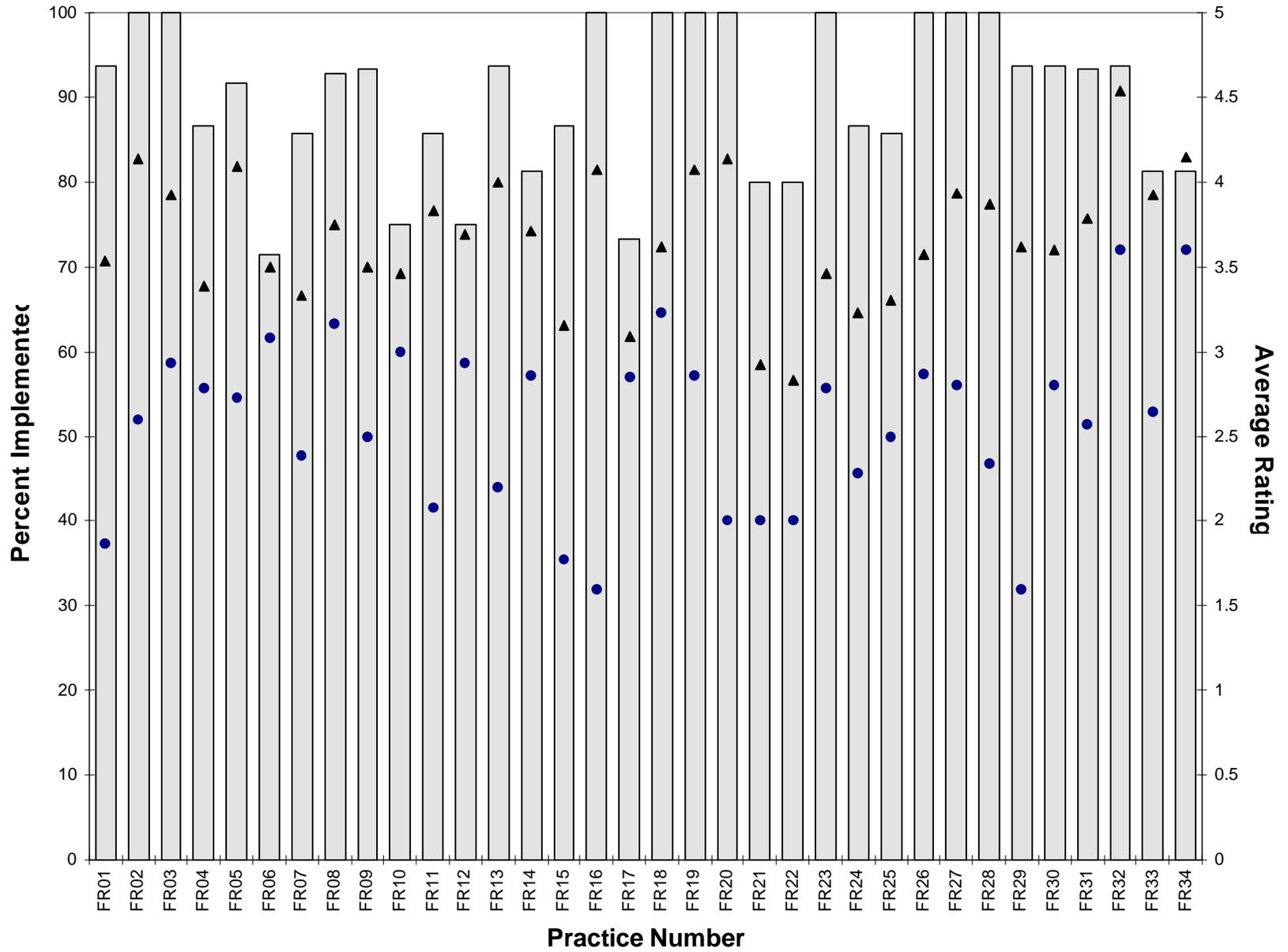
### E911 Focus Team



□ Implementation ▲ Effectiveness ● Cost

Ratings: 5 - Very High to 1 - Very Low

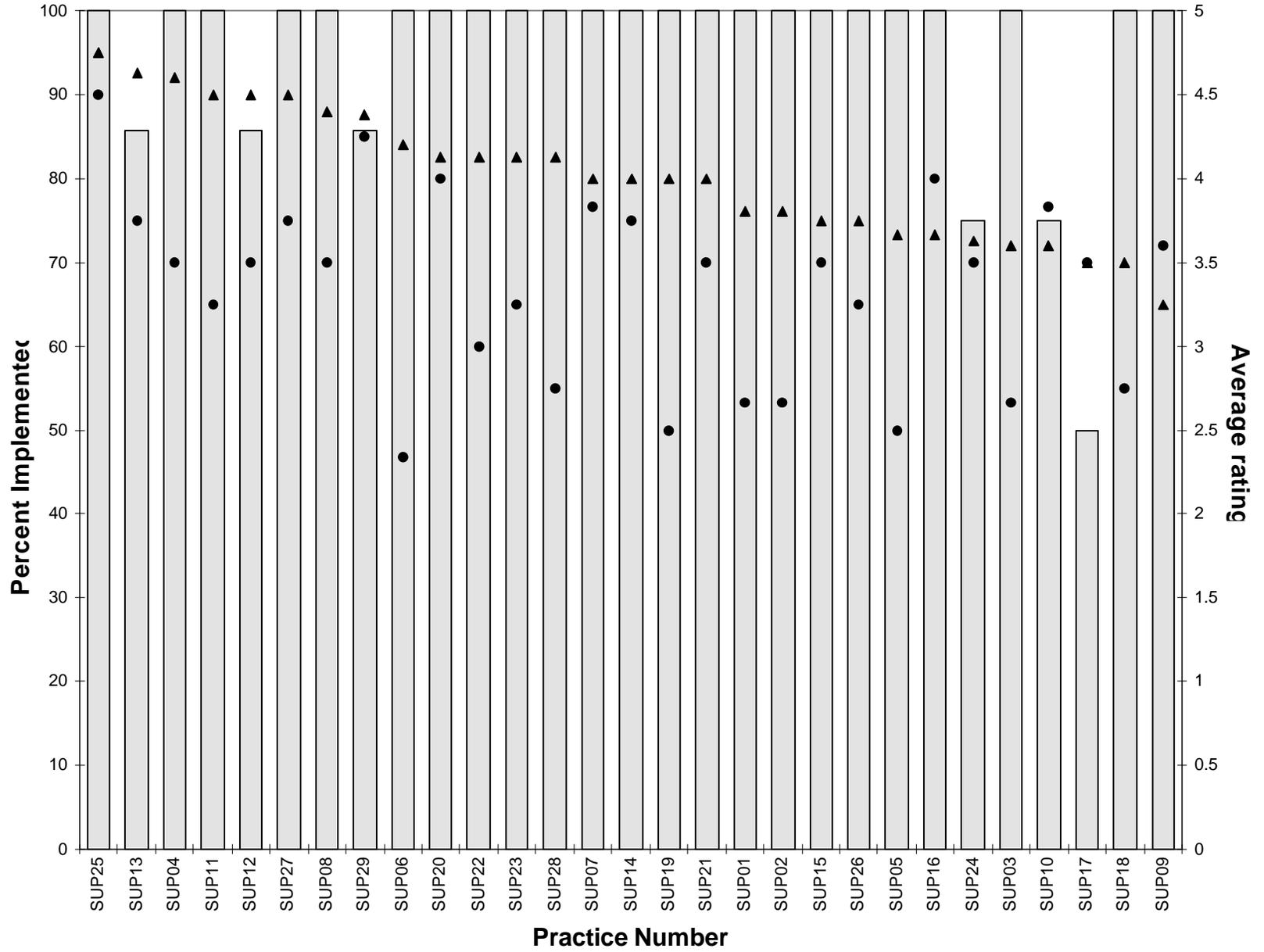
### Fire Focus Team



□ Implementation ▲ Effectiveness ● Cost

Ratings: 5 - Very High to 1 - Very Low

### Supplier Best Practices



□ Implementation ▲ Effectiveness ● Cost

Ratings: 5 - Very High to 1 - Very Low

## 8.0 Exhibits

### **8.3 Cross reference relating questionnaire to results chart**

Exhibit 8.3

Questionnaire	Current Listing
Service Provider Questionnaire	
1	FB01
2	FB02
3	FB03
4	FB04
5	FB05
6	FB06
7	FB07
8	FB08
9	FB09
10	FB10
11	FB11
12	FB12
13	FB13
14	FB14
15	FB15
16	FB16
17	FB17
18	FB18
19	FB19
20	FB20
21	FB21
22	FB22
23	FB23
24	FB24
25	FB25
26	FB26
27	SN01
28	SN02
29	SN03
30	SN04
31	SN05
32	SN06
33	SN07
34	SN08
35	SN09
36	SN10
37	SN11
38	SN12
39	SN13
40	SN14
41	SN15
42	SW01
43	SW02
44	SW03
45	SW04
46	SW05

Questionnaire	Current Listing
47	SW06
48	SW07
49	SW08
50	DX01
51	DX02
52	DX03
53	DX04
54	DX05
55	DX06
56	DX07
57	DX08
58	DX09
59	DX10
60	DX11
61	DX12
62	DX13
63	DX14
64	DX15
65	DX16
66	DX17
67	DX18
68	DX19
69	DX20
70	DX21
71	DX22
72	DX23
73	DX24
74	DX25
75	DX26
76	DX27
77	DX28
78	DX29
79	DX30
80	DX31
81	DX32
82	DX33
83	PW01
84	PW02
85	PW03
86	PW04
87	PW05
88	PW06
89	PW07
90	PW08
91	PW09
92	PW10
93	PW11

Exhibit 8.3

Questionnaire	Current Listing
94	PW12
95	PW13
96	PW14
97	PW15
98	PW16
99	PW17
100	PW18
101	PW19
102	PW20
103	PW21
104	PW22
105	PW23
106	PW24
107	PW25
108	PW26
109	ES17
110	ES27
111	ES26
112	ES01
113	ES02
114	ES03
115	ES04
116	ES12
117	ES13
118	ES06
119	ES07
120	ES16
121	ES08
122	ES09
123	ES10
124	ES11
125	ES05
126	ES14
127	ES15
128	ES18
129	ES19
130	ES20
131	ES21
132	ES22
133	ES23
134	ES24
135	ES25
136	FR01
137	FR02
138	FR03
139	FR04
140	FR05

Questionnaire	Current Listing
141	FR06
142	FR07
143	FR08
144	FR09
145	FR10
146	FR11
147	FR12
148	FR13
149	FR14
150	FR15
151	FR16
152	FR17
153	FR18
154	FR19
155	FR20
156	FR21
157	FR22
158	FR23
159	FR24
160	FR25
161	FR26
162	FR27
163	FR28
164	FR29
165	FR30
166	FR31
167	FR32
168	FR33
169	FR34
Supplier Questionnaire	
1	SUP01
2	SUP02
3	SUP03
4	SUP04
5	SUP05
6	SUP06
7	SUP07
8	SUP08
9	SUP09
10	SUP10
11	SUP11
12	SUP12
13	SUP13
14	SUP14
15	SUP15
16	SUP16
17	SUP17

Exhibit 8.3

<b>Questionnaire</b>	<b>Current Listing</b>
18	SUP18
19	SUP19
20	SUP20
21	SUP21
22	SUP22
23	SUP23
24	SUP24
25	SUP25
26	SUP26
27	SUP27
28	SUP28
29	SUP29

Appendix 1

**Issue Statement**

**Network Reliability Council  
Issue Statement**

**Issue Title: Network Reliability Performance**

- **Local & Regional Basis**
- **Geographic and Demographic Impact**

*Team Leader:*  
*Raymond Albers - Bell Atlantic*

*Steering Committee Champion:*  
*Frank Ianna - AT&T*

**Problem Statement/Issues to be Addressed**

The first Network Reliability Council recommended that the industry establish a group to monitor network reliability utilizing outage reports filed with the FCC as a high level indicator of network reliability. The Network Reliability Steering Committee (NRSC) sponsored by the Alliance for Telecommunications Industry Solutions (ATIS) was established in May 1993 and has to date issued weekly summaries of outage reports, five quarterly reports, and will release its first annual report in October 1994. The NRSC's analysis to date has been focused on a national level. The Network Reliability Council would like the NRSC to add to its mission by analyzing the effects of outages on a local and regional basis and the geographic and demographic impact of outages, and to review the industry's implementation of the recommendations contained in the June 1993 report "Network Reliability: A Report to the Nation."

**Areas of Concern & Problem Quantification**

1. Local and Regional Impact of Outages - What is the distribution of outages on a local and regional basis and is there variation in the availability of network services?
2. Based on the previous analysis, are specific outages more prone to occurring in certain areas (e.g., Fiber Cuts in warmer climates - South -- Power Outages in colder climates - North)?
3. Best Practices identified in the June 1993 report "Network Reliability: A Report to the Nation" - Are the Best Practices effective in avoiding or mitigating service outages, how are they being implemented by carriers and suppliers and are some more applicable to certain geographic areas? In addition, are the best practices applicable to other telecommunications networks (e.g., cable, wireless and satellite)?

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## **Description of Proposed Work**

- 1) Local and Regional Impact of Outages - Develop (and if approved by NRC, implement) recommendations on Definition, Scope and Metrics. Examples of factors to be considered include:
  - a) Identify what data is available from which to determine the reliability of network services on a local and regional basis.
    - For example: Telco data (e.g., FCC Major Outage Reports, ARMIS)? Cellular data (e.g., FCC requires notification of outages of 90 or more continuous days). Satellite data (FCC's Laurel Satellite Monitoring Facility requests notification due to interference). Cable Data.
    - Data for other telecommunications network services.
    - What does the available data tell us about local and regional variation (if any) in the availability of network services.
  - b) What are appropriate definitions of "Regions."
  - c) Determine an appropriate baseline for service reliability measurement.
  - d) Analyze the effects of outages on a local and regional basis and determine where significant differences exist.
  - e) Evaluate the usefulness of present reporting mechanisms and available data for investigating the causes of service loss, avoidability of outages and effect of outages on particular services.
  - f) Assess how other service providers (e.g., cable, satellite, wireless, etc.) could monitor outage data similar to that reported by telcos.
  - g) Determine whether and how customers of carriers should be informed of service outages.
  
- 2) Geographic and Demographic Impact - Develop recommendations for appropriate geographic and demographic classifications, determine availability and sources of data and measures for characterizing outage impact. Examples of work include:
  - a) Evaluate the existing data and measures to determine if they are useful in analyzing geographic and demographic impact.
  - b) Determine if there are outage types more prone to certain geographic areas using currently available data (e.g., Major Outage Reports, ARMIS, NRC Technical Papers, etc.).
  - c) Investigate and enumerate ways to assess non-telco services (e.g., T1A1.2 type impact measure for cable, satellite, wireless, etc. ).
  - d) Evaluate the need and develop plans for further and continuing data collection.
  
- 3) Best Practices - Recommend and implement relevant measures of the industry's implementation of Best Practices. Examples of possible factors to be considered include:
  - a) Determine if and to what extent industry is implementing applicable best practices (what do the quarterly and annual NRSC reports show).
  - b) Evaluate the effectiveness of applicable best practices for avoiding or mitigating service outages?
  - c) Determine the cost/value of applicable best practices.

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- d) Determine if there are additional or new best practices which should be added to the current set being utilized in industry today.
- e) Evaluate if best practices have more applicability and effectiveness in certain geographical areas.

## **Existing Work Efforts**

1. The NRSC solicited input from industry, for inclusion in its first Annual Report, to better understand how carriers and manufacturers went about evaluating, implementing and sharing the ideas and best practices contained in the FCC's "Network Reliability: A Report to the Nation." The NRSC requested input on the general approach to a) Follow-up on NRC recommendations, b) Specific recommendations which have been implemented and shown to be effective, c) Examples where implementation of Best Practices have resulted in improvement and d) Whether NRC recommendations resulted in closer cooperation and coordination in the resolution of outages. These voluntarily supplied data can form the basis for a preliminary report to the NRC.
2. Working group T1A1.2 has identified fifteen areas of future work related to identifying more appropriate methods and associated data to estimate the impact of network outages. These work items include the development of better outage index calculation methods for combined outages, consideration of weekend traffic patterns for modifying the time factors utilized, consideration of redefining services affected and service weights, and the development of new outage reporting criteria based on the network outage impact.
3. The Network Operations Forum (NOF) undertook a review and analysis of all NRC recommendations to identify potential NOF activities and issues. This resulted in the development of a matrix, mapping NOF activity and issues to the NRC recommendations, and the introduction of five new issues.
4. The NOF, through its Internetwork Interoperability Test Plan (IITP) Committee continues to be active in developing test scripts and test configurations, overseeing the performance of the tests and the reporting of test results to the industry. Test scripts have been developed and performed reflecting new and revised standards and requirements. Test Phases are scheduled through 1995.

## **Team Participants:**

Network Reliability Steering Committee (Ray Albers - Bell Atlantic)

- Process and Procedures Team (PJ Aduskevicz - AT&T)

Network Reliability Performance Committee:

- > Performance Metric Team (Eva Low - Pacific) **H**
- > Best Practices Team (Rick Harrison - NOF)
- > Outage Reporting & Notification Team (Ray Albers - Bell Atlantic)
- Data Assembly and Analysis Team (Harold Daugherty - Bell Atlantic)

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Appendix 2

**Questionnaires**

# NRC Focus Group 1 - Network Reliability Performance Best Practices Questionnaire for Service Providers

Company Name: \_\_\_\_\_

Contact Name: \_\_\_\_\_ Telephone: \_\_\_\_\_

## Part 1

This part of the questionnaire asks about how your company is managing ~~the~~ process for tracking and implementing the Best Practices. For questions 1 through 7 please check the appropriate box for your answer. Question 8 is an “essay” question.

1. Has an individual or organization been designated as “owner” of the Best Practices list?  Yes  No
2. Have individuals and/or organizations been designated as accountable for implementation of Best Practices?  Yes  No
3. Is implementation of Best Practices tracked/monitored?  Yes  No
4. Has a form of measurement been established for:
  - a. Determining percentage of Best Practices implemented  Yes  No
  - b. Assessing impact on network reliability of Best Practices implemented  Yes  No
  - c. Assessing impact on network reliability of Best Practices ~~not~~ implemented  Yes  No
5. Can you relate the impact of implemented Best Practices with quantifiable/measurable results?  Yes  No
6. Do you have a plan for implementation of Best Practices?  Yes  No
7. Do you have commitment/support to implement the plan?  Yes  No
8. How widely understood or known within your company are Best Practices recommendations contained in *Network Reliability: A Report to the Nation*?

## Part 2 (Optional)

Do you have any case studies or specific examples where Best Practices you implemented have been particularly effective in preventing or minimizing network outages? Please attach descriptions of these case studies.

# NRC Focus Group 1 - Network Reliability Performance Best Practices Questionnaire for Suppliers

Company Name: \_\_\_\_\_

Contact Name: \_\_\_\_\_ Telephone: \_\_\_\_\_

## Part 1

This part of the questionnaire asks about how your company is managing ~~the~~ process for tracking and implementing the Best Practices. For questions 1 through 7 please check the appropriate box for your answer. Question 8 is an “essay” question.

1. Has an individual or organization been designated as “owner” of the Best Practices list?  Yes  No
2. Have individuals and/or organizations been designated as accountable for implementation of Best Practices?  Yes  No
3. Is implementation of Best Practices tracked/monitored?  Yes  No
4. Has a form of measurement been established for:
  - a. Determining percentage of Best Practices implemented  Yes  No
  - b. Assessing impact on network reliability of Best Practices implemented  Yes  No
  - c. Assessing impact on network reliability of Best Practices ~~not~~ implemented  Yes  No
5. Can you relate the impact of implemented Best Practices with quantifiable/measurable results?  Yes  No
6. Do you have a plan for implementation of Best Practices?  Yes  No
7. Do you have commitment/support to implement the plan?  Yes  No
8. How widely understood or known within your company are the Best Practices recommendations contained in *Network Reliability: A Report to the Nation*?

## Part 2 (Optional)

Do you have any case studies or specific examples where Best Practices you implemented have been particularly effective in preventing or minimizing network outages? Please attach descriptions of these case studies.

**Part 3**

**NRC Best Practices Questionnaire for Service Providers**

ID	Focus Team	Recommendation	Purple Book Reference	Categories		Implementation			Value
				Obsolete? (Y -Yes Blank -No)	Relative Cost to Implement (VL, L, M, H, VH)	Implemented (F-Fully, P-Partially N-Not)	Planned (Y,N)	Alternate Solution (Y,N)	Effectiveness Rating (1- 5) (0-Don't Know)
1	Fiber	Adherence to Procedures	A-6.1.3						
2	Fiber	Warning Tape	A-6.1.3						
3	Fiber	Visible Cable Marking	A-6.1.3						
4	Fiber	Respond to Locate Requests	A-6.1.3						
5	Fiber	Accurate Locates	A-6.1.3						
6	Fiber	Enhanced Locating Equipment	A-6.1.3						
7	Fiber	Use of Plant Route Maps	A-6.1.3						
8	Fiber	Hand Dig in Safety Zone	A-6.1.3						
9	Fiber	Technician Supervision	A-6.1.3						
10	Fiber	On-Line Technical Support	A-6.1.3						
11	Fiber	Cooperation With Contractors	A-6.1.3						
12	Fiber	Training	A-6.1.3						
13	Fiber	Contractor Awareness	A-6.1.3						
14	Fiber	Contact With Land Owners	A-6.1.3						
15	Fiber	Patrol Cable Routes	A-6.1.3						
16	Fiber	Audits/Surveys of Plant	A-6.1.3						
17	Fiber	Barriers	A-6.1.3						
18	Fiber	Buried Cable	A-6.1.3						
19	Fiber	Buried Facilities	A-6.1.3						
20	Fiber	Shielding	A-6.1.3						

**Part 3**

**NRC Best Practices Questionnaire for Service Providers**

ID	Focus Team	Recommendation	Purple Book Reference	Categories		Implementation			Value
				Obsolete? (Y -Yes Blank -No)	Relative Cost to Implement (VL, L, M, H, VH)	Implemented (F-Fully, P-Partially N-Not)	Planned (Y,N)	Alternate Solution (Y,N)	Effectiveness Rating (1- 5) (0-Don't Know)
21	Fiber	Protective Devices	A-6.1.3						
22	Fiber	Stronger Conduit	A-6.1.3						
23	Fiber	Separate Pole Lines	A-6.1.3						
24	Fiber	No Visible Markings	A-6.1.3						
25	Fiber	Secured Manholes	A-6.1.3						
26	Fiber	Ventilate Manholes	A-6.1.3						
27	SNS	Awareness Training Program	B-5.2.4.5						
28	SNS	Architectural Alternatives	B-5.2.4.5						
29	SNS	Off-Peak Scheduling	B-5.2.4.5						
30	SNS	STP Maintenance Personnel Training	B-5.2.5.4						
31	SNS	Evaluation & Periodic Maintenance of SCP UPS	B-5.2.6.2						
32	SNS	Place SCPs in CO Environment	B-5.2.6.2						
33	SNS	Maintain A-Link Diversity	B-5.2.7.1.1, 6.2.1						
34	SNS	Review Rehome Procedures	B-5.2.8						
35	SNS	Review Detection & Manual Intervention Procedures	B-5.2.8						
36	SNS	Training in Trouble Detection & Isolation	B-5.2.8						
37	SNS	Training in Power Equipment Maintenance	B-5.2.8						
38	SNS	Failure Data Collect. & Root Cause Analysis	B-6.1.1						
39	SNS	Signaling Information Sharing	B-6.1.2						
40	SNS	Evaluate TIRKS Enhancements	B-6.2.1.4						

Part 3

NRC Best Practices Questionnaire for Service Providers

ID	Focus Team	Recommendation	Purple Book Reference	Categories		Implementation			Value
				Obsolete? (Y -Yes Blank -No)	Relative Cost to Implement (VL, L, M, H, VH)	Implemented (F-Fully, P-Partially N-Not)	Planned (Y,N)	Alternate Solution (Y,N)	Effectiveness Rating (1- 5) (0-Don't Know)
41	SNS	Develop Crisis Management Exercises	B-6.2.2						
42	SW	Failure Data Collection & Root Cause Analysis	C-5.1.3, 5.2.3, 5.3.3						
43	SW	MOP for Hardware & Software Growth	C-5.1.3(3)						
44	SW	Establish Manual System Reinitialization Procedures	C-5.1.3(4)						
45	SW	Establish Objectives for Number of Scheduled Outages	C-5.2.3						
46	SW	Reduce Requirements Need for Scheduled Outages	C-5.2.3(5)						
47	SW	Coordinate Reinitializations & Improve Manual Procedures	C-5.2.3(6-7)						
48	SW	Implement New Requirements	C-5.5.3(3)						
49	SW	Negotiate Service Provider - Network Provider Reliability Agreements	C-5.5.3(4)						
50	DCS	Institute DCS Awareness Program	D-6.1.1						
51	DCS	Emulate Switching Environment for DCSs	D-6.1.1						
52	DCS	Collaboration on Root Cause Analysis	D-6.1.1						
53	DCS	Establish Core Team to Plan, Test and Evaluate Change Activities	D-6.1.2						
54	DCS	Validate Upgrades in Lab Environment	D-6.1.2						
55	DCS	Establish Standard Parameters & Office Settings	D-6.1.2						
56	DCS	Validate New Procedures & Commands	D-6.1.2						
57	DCS	Establish "Change Management" Group	D-6.1.2						
58	DCS	Restrict Commands Available to Technicians	D-6.1.3						
59	DCS	Ensure Facility & DCS Databases in Sync	D-6.1.3						
60	DCS	Develop Procedures for Manual Provisioning	D-6.1.3						

**Part 3**

**NRC Best Practices Questionnaire for Service Providers**

ID	Focus Team	Recommendation	Purple Book Reference	Categories		Implementation			Value
				Obsolete? (Y -Yes Blank -No)	Relative Cost to Implement (VL, L, M, H, VH)	Implemented (F-Fully, P-Partially N-Not)	Planned (Y,N)	Alternate Solution (Y,N)	Effectiveness Rating (1- 5) (0-Don't Know)
61	DCS	Initiate Procedures to Review Passwords	D-6.1.3						
62	DCS	Use Callback Modems	D-6.1.3						
63	DCS	Establish Procedure to Uninhibit Alarms after Provisioning	D-6.1.3						
64	DCS	Provide Capacity to Process Alarms & Control the DCS	D-6.1.4						
65	DCS	For Service Restoration, Provide Fully Redundant Communication Links	D-6.1.4						
66	DCS	Eliminate Silent Failures	D-6.1.4, 6.1.8						
67	DCS	Establish Centralized Support Organization	D-6.1.5						
68	DCS	Establish Performance Levels	D-6.1.6						
69	DCS	Establish Disaster Recovery Plans	D-6.1.7						
70	DCS	Failure Data Collection & Root Cause Analysis	D-6.1.7,7						
71	DCS	Schedule System Backups	D-6.1.8						
72	DCS	Ensure Adequate Documentation	D-6.2.1, 6.2.2, 6.2.3						
73	DCS	Document System Overview & Procedures	D-6.2.4						
74	DCS	Develop Acceptance Testing Checkoff Sheet	D-6.2.4						
75	DCS	Include Troubleshooting Flowcharts in Documentation	D-6.2.4						
76	DCS	Use Human Factors Considerations in Documentation Development	D-6.2.5						
77	DCS	Institute DCS Technician Certification Programs	D-6.2.11						
78	DCS	Have Sufficient Spares	D-6.4.1(b)						
79	DCS	Deploy Systems with Redundant Disk Drives	D-6.4.1(c)						
80	DCS	Insist on Suppliers Providing Reliability Data to Prove Designs Meet Network Criteria	D-6.4.2(b)						

**Part 3**

**NRC Best Practices Questionnaire for Service Providers**

ID	Focus Team	Recommendation	Purple Book Reference	Categories		Implementation			Value
				Obsolete? (Y -Yes Blank -No)	Relative Cost to Implement (VL, L, M, H, VH)	Implemented (F-Fully, P-Partially N-Not)	Planned (Y,N)	Alternate Solution (Y,N)	Effectiveness Rating (1- 5) (0-Don't Know)
81	DCS	Revisit Reliability Requirements & Reallocate Failure Rates	D-6.5.1, 6.5.2						
82	DCS	Revisit DCS Sizing	D-6.5.4						
83	Power	Increase Emphasis on Operational Factors	E-1						
84	Power	Eliminate Single Points of Failure	E-6(2)						
85	Power	Adhere to Standards	E-6(3)						
86	Power	Coordinate with Electric Utilities	E-6.1, 6.13.2(4)						
87	Power	Adhere to Established Best Practices for Commercial Power	E-6.1.9						
88	Power	Adhere to Established Best Practices for Standby Generators	E-6.2.2						
89	Power	Adhere to Established Best Practices for Building AC Systems	E-6.3.1						
90	Power	Adhere to Established Best Practices for DC Plants	E-6.4.1						
91	Power	Adhere to Established Best Practices for DC Distribution Systems	E-6.4.1						
92	Power	Adhere to Established Best Practices for Alarms & Remote Monitoring	E-6.6.4						
93	Power	Employ Specialized Teams	E-6.7						
94	Power	Adhere to Established Best Practices for Operations & Maintenance	E-6.7.1						
95	Power	Adhere to Established Best Practices for Installation/Removal Work	E-6.8.2						
96	Power	Maintain & Exercise Site-Specific Procedures	E-6.9						
97	Power	Put Standby Engines Online Before Power Fails in Storms	E-6.13.1(1)						
98	Power	Design Standby Systems for Wind and Rain in Coastal Areas	E-6.13.1(2)						
99	Power	Improve Fuel Systems Reliability: Design & Maintenance	E-6.13.1(3)						
100	Power	Automatic Reserve Lubrication Oil Makeup Systems	E-6.13.1(4)						

**Part 3**

**NRC Best Practices Questionnaire for Service Providers**

ID	Focus Team	Recommendation	Purple Book Reference	Categories		Implementation			Value
				Obsolete? (Y -Yes Blank -No)	Relative Cost to Implement (VL, L, M, H, VH)	Implemented (F-Fully, P-Partially N-Not)	Planned (Y,N)	Alternate Solution (Y,N)	Effectiveness Rating (1- 5) (0-Don't Know)
101	Power	Automatic AC Transfer Switches Instead of Paired Circuit Breakers	E-6.13.1(5)						
102	Power	Local Procedures and Contingency Plans for Power Emergencies	E-6.13.1(6)						
103	Power	AC Tap Boxes Outside COs for Portable Engines	E-6.13.1(7)						
104	Power	Remote Power Monitors	E-6.13.1(8)						
105	Power	Power Expertise/Power Teams	E-6.13.1(9)						
106	Power	Fewer but Larger DLC RTs with Bulk Power	E-6.13.2(1)						
107	Power	Security of Portable Generators	E-6.13.2(2)						
108	Power	Diesel Portable Generators	E-6.13.2(3)						
<p><b>Please answer the questions on the following 911 best practices as applied in metropolitan areas (Non-metropolitan application is addressed below.)</b></p>									
109	E911	Evaluate Trend toward Increased Concentration of 911 Capabilities	F-1.3, 6.2						
110	E911	Defer Use of CCS Network Until Protocol Issues Addressed by Standards Bodies	F-1.3, 6.7						
111	E911	Improve Communications Among LECs, Administrators & Public Safety Agencies	F-1.3						
112	E911	50% of 911 Circuits Provisioned on Each of Two Diverse Interoffice Facilities	F-6.1.1, Fig. 6-2						
113	E911	Automatic Switching of 911 Circuits to a Diverse Standby Protection Facility	F-6.1.1						
114	E911	Diverse Interoffice Facilities from Customer End Office Home onto Two Diverse DCSs	F-6.1.1, Fig. 6-3						
115	E911	Fiber Ring Topologies for 911 Circuits	F-6.1.1.1, Fig. 6-4						
116	E911	Two 911 Tandems to Serve a Single Customer and the PSAP	F-6.1.2.1, 6.2.1, Fig. 6-5						
117	E911	Re-homing to Back-up 911 Tandem Switch	F-6.1.2.2, 6.2.2, Fig. 6-6						
118	E911	Alternate PSAPs off the 911 Tandem Switch	F-6.1.3.1, Fig. 6-7						
119	E911	Alternate PSAPs off the End Office	F-6.1.3.1, Fig. 6-7						

Part 3

NRC Best Practices Questionnaire for Service Providers

ID	Focus Team	Recommendation	Purple Book Reference	Categories		Implementation			Value
				Obsolete? (Y -Yes Blank -No)	Relative Cost to Implement (VL, L, M, H, VH)	Implemented (F-Fully, P-Partially N-Not)	Planned (Y,N)	Alternate Solution (Y,N)	Effectiveness Rating (1- 5) (0-Don't Know)
120	E911	Operator Services Tandem as Backup for 911	F-6.1.3.2, Fig. 6-8						
121	E911	Public Switched Network as Back-up for 911 Dedicated Trunks	F-6.1.3.3, Fig. 6-9						
122	E911	Cellular Network as Back-up	F-6.1.3.4, Fig. 6-10						
123	E911	Intraoffice Call Termination to Mobile PSAP when Office is Isolated	F-6.1.3.5, Fig.6-11						
124	E911	Back-up PSAP Permanently Located Within the Central Office	F-6.1.3.5						
125	E911	Red-tagged, Diverse Equipment within a Central Office	F-6.1.4						
126	E911	Diverse Paired 911 Tandem Switches	F-6.2.1						
127	E911	Multiple Diverse 911 Tandem Switches with Paired Diverse DCSs	F-6.2.2, Fig. 6-6						
128	E911	Local Loop Diversity for Larger PSAPs	F-6.3						
129	E911	911 Network Management Center & Procedures to Manage and Prioritize Repairs	F-6.4						
130	E911	Diverse ALI Database Systems	F-6.5, Fig. 6-14						
131	E911	Move Mass Calling Stimulator Away from 911 Tandem Switch	F-6.6, Fig. 6-15						
132	E911	Pre-planning and Cooperation to Minimize Effects of Mass Calling Events	F-6.6						
133	E911	Contingency Plan Development for Emergency 911 Service	F-6.7.1						
134	E911	Contingency Plan Training for Emergency 911 Service	F-6.7.1						
135	E911	Public Education on Proper Use of 911 Service	F-6.7.1						
<p><b>Please answer the same questions on the 911 best practices as applied in non-metropolitan areas.</b></p>									
109	E911	Evaluate Trend toward Increased Concentration of 911 Capabilities	F-1.3, 6.2						
110	E911	Defer Use of CCS Network Until Protocol Issues Addressed by Standards Bodies	F-1.3, 6.7						
111	E911	Improve Communications Among LECs, Administrators & Public Safety Agencies	F-1.3						

Part 3

NRC Best Practices Questionnaire for Service Providers

ID	Focus Team	Recommendation	Purple Book Reference	Categories		Implementation			Value
				Obsolete? (Y -Yes Blank -No)	Relative Cost to Implement (VL, L, M, H, VH)	Implemented (F-Fully, P-Partially N-Not)	Planned (Y,N)	Alternate Solution (Y,N)	Effectiveness Rating (1- 5) (0-Don't Know)
112	E911	50% of 911 Circuits Provisioned on Each of Two Diverse Interoffice Facilities	F-6.1.1, Fig. 6-2						
113	E911	Automatic Switching of 911 Circuits to a Diverse Standby Protection Facility	F-6.1.1						
114	E911	Diverse Interoffice Facilities from Customer End Office Home onto Two Diverse DCSs	F-6.1.1, Fig. 6-3						
115	E911	Fiber Ring Topologies for 911 Circuits	F-6.1.1.1, Fig. 6-4						
116	E911	Two 911 Tandems to Serve a Single Customer and the PSAP	F-6.1.2.1, 6.2.1, Fig. 6-5						
117	E911	Re-homing to Back-up 911 Tandem Switch	F-6.1.2.2, 6.2.2, Fig. 6-6						
118	E911	Alternate PSAPs off the 911 Tandem Switch	F-6.1.3.1, Fig. 6-7						
119	E911	Alternate PSAPs off the End Office	F-6.1.3.1, Fig. 6-7						
120	E911	Operator Services Tandem as Backup for 911	F-6.1.3.2, Fig. 6-8						
121	E911	Public Switched Network as Back-up for 911 Dedicated Trunks	F-6.1.3.3, Fig. 6-9						
122	E911	Cellular Network as Back-up	F-6.1.3.4, Fig. 6-10						
123	E911	Intraoffice Call Termination to Mobile PSAP when Office is Isolated	F-6.1.3.5, Fig.6-11						
124	E911	Back-up PSAP Permanently Located Within the Central Office	F-6.1.3.5						
125	E911	Red-tagged, Diverse Equipment within a Central Office	F-6.1.4						
126	E911	Diverse Paired 911 Tandem Switches	F-6.2.1						
127	E911	Multiple Diverse 911 Tandem Switches with Paired Diverse DCSs	F-6.2.2, Fig. 6-6						
128	E911	Local Loop Diversity for Larger PSAPs	F-6.3						
129	E911	911 Network Management Center & Procedures to Manage and Prioritize Repairs	F-6.4						
130	E911	Diverse ALI Database Systems	F-6.5, Fig. 6-14						
131	E911	Move Mass Calling Stimulator Away from 911 Tandem Switch	F-6.6, Fig. 6-15						

Part 3

NRC Best Practices Questionnaire for Service Providers

ID	Focus Team	Recommendation	Purple Book Reference	Categories		Implementation			Value
				Obsolete? (Y -Yes Blank -No)	Relative Cost to Implement (VL, L, M, H, VH)	Implemented (F-Fully, P-Partially N-Not)	Planned (Y,N)	Alternate Solution (Y,N)	Effectiveness Rating (1- 5) (0-Don't Know)
132	E911	Pre-planning and Cooperation to Minimize Effects of Mass Calling Events	F-6.6						
133	E911	Contingency Plan Development for Emergency 911 Service	F-6.7.1						
134	E911	Contingency Plan Training for Emergency 911 Service	F-6.7.1						
135	E911	Public Education on Proper Use of 911 Service	F-6.7.1						
<b>The remaining questions apply to both metropolitan and non-metropolitan areas considered together</b>									
136	Fire	Develop Pre-plans with Fire Agencies	G-6.2.1						
137	Fire	Verify Smoke/Heat Detection Capability	G-6.2.2						
138	Fire	Meet NEBS Requirements for Power & Communication Cables	G-6.2.3A						
139	Fire	Consider Non-reuse of Noncompliant Cable	G-6.2.3B						
140	Fire	Use ANSI T1.311-1991 for COs	G-6.2.4						
141	Fire	Test All Pre-1989 VRLA Batteries	G-6.2.5C						
142	Fire	Establish Case History File by Equipment Category for Rectifiers	G-6.2.7A						
143	Fire	Locate Transformers External to Buildings	G-6.2.9						
144	Fire	Regularly Inspect Motors	G-6.2.10						
145	Fire	Exercise & Calibrate Circuit Breakers	G-6.2.11						
146	Fire	Use Defined Procedure for Cable Mining	G-6.3.1						
147	Fire	Implement a Certification & Training Program for Contractors	G-6.3.2						
148	Fire	Develop & Execute a Standard MOP for Vendor Work	G-6.3.3						
149	Fire	Develop Site Management & Building Certification Program	G-6.4.1, 6.6.1, 6.7.1						
150	Fire	Review Practices on Use of Soldering Irons	G-6.4.2						

**Part 3**

**NRC Best Practices Questionnaire for Service Providers**

ID	Focus Team	Recommendation	Purple Book Reference	Categories		Implementation			Value
				Obsolete? (Y -Yes Blank -No)	Relative Cost to Implement (VL, L, M, H, VH)	Implemented (F-Fully, P-Partially N-Not)	Planned (Y,N)	Alternate Solution (Y,N)	Effectiveness Rating (1- 5) (0-Don't Know)
151	Fire	Prohibit Smoking in Buildings	G-6.4.3						
152	Fire	Verify Aerial Powerlines are Not in Conflict with Hazards	G-6.5.1						
153	Fire	Provide AC Surge Protection	G-6.5.2						
154	Fire	Verify Grounding Arrangements	G-6.5.3						
155	Fire	Assure Programs Exist for Alarm Testing	G-6.5.4						
156	Fire	Avoid Use of Combustible Landscape Material	G-6.6.2						
157	Fire	Verify Dumpster Location	G-6.6.3						
158	Fire	Insure Proper Air Filtration	G-6.6.4						
159	Fire	Administer Elevator Routines	G-6.7.2						
160	Fire	Verify Elevator Building Compartments Comply with Code	G-6.7.3						
161	Fire	Provide Smoke Detection and Ventilation in Motor Room	G-6.7.4						
162	Fire	Use Over-current Protection Devices and Fusing	G-6.7.5						
163	Fire	Inspect and Maintain HVAC areas	G-6.7.6						
164	Fire	Restrict Use of Space Heaters	G-6.7.7						
165	Fire	Establish Building Equipment Maintenance Program	G-6.7.8						
166	Fire	Certified Inspection of Boilers & Fuel Storage Units	G-6.7.9						
167	Fire	Provide All Critical Facilities with a Modern Smoke Detection System	G-8						
168	Fire	Provide Automatic Notification of Local Fire Department	G-9						
169	Fire	Implement Early Smoke Detection and Appropriate Ventilation Systems	G-10						

Part 3

NRC Best Practices Questionnaire for Suppliers

ID	Focus Team	Recommendation	Purple Book Reference	Categories		Implementation			Value
				Obsolete? (Y -Yes Blank -No)	Relative Cost to Implement (VL, L, M, H, VH)	Implemented (F-Full, P-Partial N-Not)	Planned (Y,N)	Alternate Solution (Y,N)	Effectiveness Rating (1- 5) (0-Don't Know)
<b>The following best practices are addressed to switch suppliers (including STP and SCP suppliers)</b>									
1	SNS	Software Fault Insertion	B-5.2.4.5, 5.2.5.4.						
2	SNS	Hardware Fault Insertion	B-5.2.4.5, 5.2.5.4.						
3	SNS	Review of Fault Recovery Actions	B-5.2.4.5, 5.2.5.4.						
4	SNS	Minimize Initialization Durations	B-5.2.4.5, 5.2.5.4.						
5	SNS	Place Added Emphasis on Human Factors Design	B-5.2.7.1.1						
6	SNS	Failure Data Collect. & Root Cause Analysis	B-6.1.1						
7	SW	Enhance System Defensiveness to Service Affecting Activity	C-5.1.3						
8	SW	Reduce Need for Scheduled Outages	C-5.2.3(1-4)						
9	SW	Hardware & Software Fault Recovery Design Convergence	C-5.3.3(5-6))						
10	SW	Enhance Software Development Methodology	C-5.4.3(1-10)						
<b>The following best practices are addressed to DCS suppliers</b>									
11	DCS	Collaboration on Root Cause Analysis	D-6.1.1						
12	DCS	Establish Core Team to Plan, Test and Evaluate Change Activities	D-6.1.2						
13	DCS	Validate Upgrades in Lab Environment	D-6.1.2						
14	DCS	Eliminate Silent Failures	D-6.1.4, 6.1.8						
15	DCS	Establish Performance Levels	D-6.1.6						
16	DCS	Ensure Adequate Documentation	D-6.2.1, 6.2.2, 6.2.3						
17	DCS	Establish Change Control Database	D-6.2.3						

**Part 3**

**NRC Best Practices Questionnaire for Suppliers**

ID	Focus Team	Recommendation	Purple Book Reference	Categories		Implementation			Value
				Obsolete? (Y -Yes Blank -No)	Relative Cost to Implement (VL, L, M, H, VH)	Implemented (F-Full, P-Partial N-Not)	Planned (Y,N)	Alternate Solution (Y,N)	Effectiveness Rating (1- 5) (0-Don't Know)
18	DCS	Document System Overview & Procedures	D-6.2.4						
19	DCS	Develop Acceptance Testing Checkoff Sheet	D-6.2.4						
20	DCS	Include Troubleshooting Flowcharts in Documentation	D-6.2.4						
21	DCS	Use Human Factors Considerations in Documentation Development	D-6.2.5						
22	DCS	Develop Training for Customer Needs with Customer Testing	D-6.2.7						
23	DCS	Update Training as Product Evolves	D-6.2.8						
24	DCS	Develop Training for Local & Centralized Tier 1/2 OAM&P Personnel	D-6.2.9, 6.2.10						
25	DCS	Improve Software Process	D-6.3						
26	DCS	Review Level of Inspection on Critical Components	D-6.4.1(a)						
27	DCS	Deploy Systems with Redundant Disk Drives	D-6.4.1(c)						
28	DCS	Improve Documentation on Backup & Recovery	D-6.4.1(d)						
29	DCS	Develop Redundant Controller Architecture	D-6.4.2(a)						

Appendix 3  
**Responses to Part 2**

# NRC Focus Group 1 - Network Reliability Performance Best Practices Questionnaire

## Responses to Part 2

1. (From a Supplier) One of the Best Practice items for software development is the use of Code Reviews. [Company] has implemented the [program name] program of software code reviews and has had more than one example of improving delivery time for software, even when the project was “behind schedule” when code reviews were started.

2. One recommendation shown to be particularly effective in prevention of outages was better root cause analysis. Several of the focus groups recommended that carriers strengthen their root cause analysis, including working with suppliers. Our new process requires a root cause analysis for the following areas: 1) Triggering Event, 2) Physical Failure Point, 3) Outage Cause, and 4) Duration Cause. The following example demonstrates the corrective actions to both prevent and minimize the chance of future occurrences of a particular outage:

EXAMPLE: A central office lost commercial power. When commercial power was restored the equipment did not switch back to commercial power, but did switch the generator off line. The battery discharge alarms worked, but personnel were not dispatched to check the problem. The batteries depleted, the switch and toll equipment failed due to loss of power. Employees were dispatched when the switch failure alarms came in. Power was restored cautiously to prevent damage. The new process would provide the following analysis:

	<b>What Happened</b>	<b>Root Cause</b>	<b>Fix</b>
Triggering Event	Commercial Power Failure	Bad/old main power company breaker at sub station. Trips with minimal transients. Breaker has tripped 4 times this year.	Power company to upgrade breaker.
Physical Failure Point	Standby generator transfer circuit breaker malfunctioned	Defective breakers tripping at less current than designed.	New breakers that meet specifications
Outage Cause	Alarms were ignored or improper response	Alarms were retarded and status queries were not performed after commercial power returned.	Procedures implemented to ensure system status queries are made after every major alarm.
Duration Root Cause	Duration of the outage was 30 minutes	The duration of the outage was 30 minutes because the dispatch of a technician was required.	None required. The technical support arrived in a timely manner.

3. [Company] would like to offer the following example of a best practice being implemented which resulted in improvement:

[Company] experience several FCC Reportable Outages involving the Common Channel Signaling Network where both A-Links serving an end office (SP/SSP) were accidentally taken out of service during maintenance activity. For example, the root cause in one case was an incorrect equipment assignment on the work document. One A-Link was being rearranged to enhance survivability. It was removed from service at the STP end. The technician working from the equipment/facility assignment document disconnected the office equipment. This action removed the second A-Link from service because the work document had the wrong equipment assignment. The documents for both A-Links were correct in all respects except for the final equipment assignments, which were transposed.

The Signaling Network Systems Committee found, in their analysis of procedural errors on SP/SSP (See Section B- 5.2.4.3), on further investigation of the data on SP/SSP failures which listed procedural errors as the cause, a major identifiable root cause of the procedural errors was the misidentification of the “unit” which required repair in those instances in which there was a redundant active unit, resulting in the SP/SSP outage. These outages, which varied from misidentification of link interfaces and link processors

## **NRC Focus Group 1 - Network Reliability Performance Best Practices Questionnaire**

to misidentification of frames or power supplies, accounted for 15% of all procedural errors, or a total of .33 minutes/year of SP/SSP downtime.

The team recommended...(See Section 5.2.4.5)....[extensive text of 5.2.4.5 quoted]

[Company] began provisioning additional A-Links (quad A-Links), initially to larger offices, as a measure to reduce the effects of these problems on customer service. However, we continued our investigation and recommended the following additional steps:

- 1) Faster second tier support involvement
- 2) Improved procedures for A-Link circuit rearrangements
- 3) Improved escalation procedures
- 4) Dual A-Link/E-Link rationale reviewed
- 5) A-Link diversity reviewed/ensured

These are just a few of the preventative measures resulting from our analysis. As a result the number of FCC reportable outages reported by [company] has declined over the past two years.

4. {Another company submitted extensive material on three examples of best practices that they have found to be particularly effective in reducing the number and/or impact of outages:

- a) Root Cause Analysis of [Failure Reports]
- b) Cable Damage Prevention QIT
- c) Guaranteed Access Provider QIT }

5. -1 Best Practices C-5.1.3 (Telco Procedures)

A. The provision of a Method of Procedure (MOP) for all hardware and software change activities has been very effective in reducing outages. Many problem areas are identified and resolved by effective planning before implementations are attempted.

B. All possible hardware and software activities are scheduled and performed in the "maintenance window" (11pm - 5am). The only exception is in the event customer service is being affected. This practice has significantly reduced negative impacts upon customer service.

-2 Best Practices C-5.4.3 (Software Design)

The recommendation to reduce the initialization execution period has caused a substantial decrease in the average scheduled outage times. We will continue to work with our vendors to make further improvements.

6. [Company] was an active participant in the NRC's Focus Teams. As a result, many of [company's] recommendations were included in the Final Focus Team reports and were based upon successes in managing [company's] network. The following are four practices that we view to be of significant importance and effectiveness:

Contractor Awareness Program (Fiber Cable Systems Focus team)

Diversity Requirements for CCS7 Network Interconnect (Signaling Network Systems Focus Team)

DCS Awareness Program (Digital Cross-Connect Systems Focus Team)

[Program name] (Power Focus Team)

## NRC Focus Group 1 - Network Reliability Performance Best Practices Questionnaire

One specific documented example that demonstrates the effectiveness of the Best Practices involves the Contractor Awareness Program referred to above. [Company] charged a team of 53 communications technicians with the task of enhancing [company's] efforts to educate the public regarding the protection of [company] cable facilities. Team members served as liaisons with various organizations and individuals that are or could be involved in digging near [company] cable. The technicians discuss the need to "Call Before You Dig" by emphasizing the impact on friends and community services, as well as the financial implications when cables are cut. Since this process has been in place, [company] has seen a **74 percent drop** in the number of cable intrusions resulting from not being notified of excavation work.

[Company] is currently enhancing this program to address those situations where [company] has cable easements (right-of-way agreements) with private property owners. The private properties were found to have generated the vast majority of "no notification" incidents during 1993. To address this area, the technician team has embarked on an effort to educate these property owners about the "Call Before You Dig" program. One strategy that is being employed is to mail each property owner a video on the "Call Before You Dig" program. The property owners will be asked to watch the video and return a short questionnaire. As an incentive for participating in the survey, respondents to the survey will be allowed to choose a small gift item. Since this program has just begun this year, an effectiveness measure is not yet available.

There are also numerous examples associated with the effectiveness of the [program name] also referred to above. This program is intended to reinforce the responsibility every employee has to ensure flawless network service. The program is based upon the following principles:

Prevention: preventing problems before they occur.

Doing the right things: rather than doing anything to get the job done.

Empowerment: being personally responsible for our own work with the power to resolve problems if quality is being compromised.

Intolerance for poor quality: questioning why things are the way they are.

Interdependence: realizing the benefits of partnerships in problem prevention.

Central to the program is the management support for employees to "Stop the Line" and resolve problems when they can't answer "Yes" to any of the [program name] questions. [Company] views this Program as a major shift in addressing the cause of errors that have traditionally been classified as "Procedural" or "Craft-Related." [Company] has found that employees are willing to "Stop the Line" before a problem occurs and management has supported this behavior. As a result, problems related to "people errors" have been significantly reduced.

7. We are currently developing a Software Fault Model to assist us in better understanding our software development processes and identifying where improvements should be made. The objectives of the fault model are the following: 1) identify areas where defects are injected, 2) identify areas where defects are currently detected, and 2) identify where gains could be made through process improvements. Although the model is still in development, data is being reported internally for [feature packages]. We are seeing very positive trends. Outage-related problem reports are included in the model. Through applying Root Cause Analysis to these problem reports we should be able to determine where the underlying defects were injected into the product during software development and develop countermeasures to prevent recurrence.

Our ultimate goals are to detect defects earlier in the development lifecycle and through understanding the causes of the defects prevent defects from occurring in the future.

Appendix 4

**High Cost to Implement/Highly Effective  
High Implementation**

**High Cost to Implement/Highly Effective  
High Implementation**

**FB09 - Technician Supervision**

**SN07 - Maintain A-Link Diversity**

**SUP04 - Minimize Initialization Durations**

**SUP07 - Enhance System Defensiveness to Service-Affecting Activity**

**SUP08 - Reduce Need for Scheduled Outages**

**SUP10 - Enhance Software Development Methodology**

**DX29 - Have Sufficient Spares**

**DX30 - Deploy Systems with Redundant Disks**

**PW02 - Eliminate Single Points of Failure**

**PW08 - Adhere to Established Best Practices for DC Plants**

**PW10 - Adhere to Established Best Practices for Alarms & Remote Monitoring**

**PW22 - Remote Power Monitors**

**PW23 - Power Expertise/Power Teams**

**PW24 - Fewer but Larger DLC Routes with Bulk Power**

**ES17 - Evaluate Trend Toward Increased Concentration**

**ES01 - 50% of 911 Circuits Provisioned on Each of Two Diverse Routes**

**ES20 - Diverse ALI Database Systems**

**FR32 - Provide all Critical Facilities with a Modern Smoke Detection System**

**FR34 - Implement Early Smoke Detection**

## Appendix 5

### **Best Practices Recommendations** Sorted by Decreasing Average Effectiveness

## Best Practices Recommendations Sorted by Decreasing Average Effectiveness Rating

ID	Focus Team	Recommendation	June 1993 Report Reference	Average Rating	
				Cost	Effectiveness
FB05	Fiber	Accurate Locates	A-6.1.3	2.79	4.54
FB08	Fiber	Hand Dig in Safety Zone	A-6.1.3	2.79	4.46
FB04	Fiber	Respond to Locate Requests	A-6.1.3	2.93	4.31
FB01	Fiber	Adherence to Procedures	A-6.1.3	2.17	4.18
FB11	Fiber	Cooperation With Contractors	A-6.1.3	2.57	4.08
FB12	Fiber	Training	A-6.1.3	3.00	3.92
FB13	Fiber	Contractor Awareness	A-6.1.3	3.14	3.77
FB19	Fiber	Buried Facilities	A-6.1.3	3.39	3.77
FB03	Fiber	Visible Cable Marking	A-6.1.3	2.54	3.75
FB06	Fiber	Enhanced Locating Equipment	A-6.1.3	3.23	3.75
FB18	Fiber	Buried Cable	A-6.1.3	3.18	3.69
FB07	Fiber	Use of Plant Route Maps	A-6.1.3	2.96	3.67
FB09	Fiber	Technician Supervision	A-6.1.3	4.00	3.67
FB20	Fiber	Shielding	A-6.1.3	2.96	3.38
FB21	Fiber	Protective Devices	A-6.1.3	3.19	3.33
FB14	Fiber	Contact With Land Owners	A-6.1.3	2.89	3.15
FB22	Fiber	Stronger Conduit	A-6.1.3	3.73	3.10
FB25	Fiber	Secured Manholes	A-6.1.3	2.89	3.09
FB02	Fiber	Warning Tape	A-6.1.3	2.54	2.92
FB15	Fiber	Patrol Cable Routes	A-6.1.3	3.79	2.91
FB26	Fiber	Ventilate Manholes	A-6.1.3	3.85	2.90
FB17	Fiber	Barriers	A-6.1.3	3.42	2.82
FB16	Fiber	Audits/Surveys of Plant	A-6.1.3	3.31	2.73
FB10	Fiber	On-Line Technical Support	A-6.1.3	3.19	2.54
FB23	Fiber	Separate Pole Lines	A-6.1.3	4.15	2.44
FB24	Fiber	No Visible Markings	A-6.1.3	1.77	2.23
SN07	Signaling	Maintain A-Link Diversity	B-5.2.7.1.1, 6.2.1	3.47	4.67
SN03	Signaling	Off-Peak Scheduling	B-5.2.4.5	2.53	4.27
SN06	Signaling	Place SCPs in CO Environment	B-5.2.6.2	2.86	4.15
SN08	Signaling	Review Rehome Procedures	B-5.2.8	2.36	4.14
SN02	Signaling	Architectural Alternatives	B-5.2.4.5	3.61	4.00
SN04	Signaling	STP Maintenance Personnel Training	B-5.2.5.4	2.93	4.00
SN05	Signaling	Evaluation & Periodic Maintenance of SCP UPS	B-5.2.6.2	2.79	4.00
SN10	Signaling	Training in Trouble Detection & Isolation	B-5.2.8	2.50	3.79
SN11	Signaling	Training in Power Equipment Maintenance	B-5.2.8	2.53	3.73

## Best Practices Recommendations Sorted by Decreasing Average Effectiveness Rating

ID	Focus Team	Recommendation	June 1993 Report	Average Rating	
			Reference	Cost	Effectiveness
SN12	Signaling	Failure Data Collection & Root Cause Analysis	B-6.1.1	2.40	3.73
SN01	Signaling	Awareness Training Program	B-5.2.4.5	2.67	3.71
SN15	Signaling	Develop Crisis Management Exercises	B-6.2.2	2.87	3.69
SN09	Signaling	Review Detection & Manual Intervention Procedures	B-5.2.8	2.43	3.57
SN13	Signaling	Signaling Information Sharing	B-6.1.2	2.27	3.47
SN14	Signaling	Evaluate TIRKS Enhancements	B-6.2.1.4	3.91	3.11
SW02	Switch	MOP for Hardware & Software Growth	C-5.1.3(3)	2.40	4.69
SW06	Switch	Coordinate Reinitializations & Improve Manual Procedures	C-5.2.3(6-7)	2.57	3.54
SW01	Switch	Failure Data Collection & Root Cause Analysis	C-5.1.3, 5.2.3, 5.3.3	2.64	3.53
SW07	Switch	Implement New Requirements	C-5.5.3(3)	3.03	3.50
SW08	Switch	Negotiate Service Provider - Network Provider Reliability Agreements	C-5.5.3(4)	2.79	3.46
SW04	Switch	Establish Objectives for Number of Scheduled Outages	C-5.2.3	2.88	3.33
SW05	Switch	Reduce Requirements Need for Scheduled Outages	C-5.2.3(5)	2.77	3.33
SW03	Switch	Establish Manual System Reinitialization Procedures	C-5.1.3(4)	1.93	3.31
DX18	DCS	Establish Centralized Support Organization	D-6.1.5	3.27	4.43
DX05	DCS	Validate Upgrades in Lab Environment	D-6.1.2	2.93	4.29
DX22	DCS	Schedule System Backups	D-6.1.8	2.40	4.21
DX29	DCS	Have Sufficient Spares	D-6.4.1(b)	3.27	4.14
DX30	DCS	Deploy Systems with Redundant Disk Drives	D-6.4.1(c)	3.47	4.14
DX03	DCS	Collaboration on Root Cause Analysis	D-6.1.1	2.20	4.08
DX25	DCS	Develop Acceptance Testing Checkoff Sheet	D-6.2.4	2.10	4.08
DX08	DCS	Establish "Change Management" Group	D-6.1.2	2.83	4.07
DX04	DCS	Establish Core Team to Plan, Test and Evaluate Change Activities	D-6.1.2	3.07	4.00
DX07	DCS	Validate New Procedures & Commands	D-6.1.2	2.67	4.00
DX17	DCS	Eliminate Silent Failures	D-6.1.4, 6.1.8	2.89	4.00
DX28	DCS	Institute DCS Technician Certification Programs	D-6.2.11	3.27	4.00
DX02	DCS	Emulate Switching Environment for DCSs	D-6.1.1	2.57	3.85
DX01	DCS	Institute DCS Awareness Program	D-6.1.1	2.60	3.83
DX15	DCS	Provide Capacity to Process Alarms & Control the DCS	D-6.1.4	3.13	3.83
DX16	DCS	For Service Restoration, Provide Fully Redundant Communication Links	D-6.1.4	3.17	3.83
DX09	DCS	Restrict Commands Available to Technicians	D-6.1.3	2.07	3.77
DX20	DCS	Establish Disaster Recovery Plans	D-6.1.7	2.73	3.77
DX06	DCS	Establish Standard Parameters & Office Settings	D-6.1.2	2.47	3.57
DX23	DCS	Ensure Adequate Documentation	D-6.2.1, 6.2.2, 6.2.3	2.40	3.57
DX24	DCS	Document System Overview & Procedures	D-6.2.4	2.18	3.57

## Best Practices Recommendations Sorted by Decreasing Average Effectiveness Rating

ID	Focus Team	Recommendation	June 1993 Report Reference	Average Rating	
				Cost	Effectiveness
DX26	DCS	Include Troubleshooting Flowcharts in Documentation	D-6.2.4	2.35	3.54
DX10	DCS	Ensure Facility & DCS Databases in Sync	D-6.1.3	2.93	3.50
DX14	DCS	Establish Procedure to Uninhibit Alarms after Provisioning	D-6.1.3	2.14	3.46
DX21	DCS	Failure Data Collection & Root Cause Analysis	D-6.1.7,7	2.50	3.42
DX27	DCS	Use Human Factors Considerations in Documentation Development	D-6.2.5	2.15	3.15
DX31	DCS	Insist on Suppliers Providing Reliability Data to Prove Designs Meet Network Criteria	D-6.4.2(b)	2.23	3.15
DX32	DCS	Revisit Reliability Requirements & Reallocate Failure Rates	D-6.5.1, 6.5.2	2.50	3.04
DX12	DCS	Initiate Procedures to Review Passwords	D-6.1.3	2.30	3.00
DX13	DCS	Use Callback Modems	D-6.1.3	3.10	3.00
DX11	DCS	Develop Procedures for Manual Provisioning	D-6.1.3	2.33	2.93
DX19	DCS	Establish Performance Levels	D-6.1.6	2.53	2.92
DX33	DCS	Revisit DCS Sizing	D-6.5.4	2.38	2.92
PW02	Power	Eliminate Single Points of Failure	E-6(2)	3.57	4.60
PW10	Power	Adhere to Established Best Practices for Alarms & Remote Monitoring	E-6.6.4	3.43	4.43
PW12	Power	Adhere to Established Best Practices for Operations & Maintenance	E-6.7.1	3.00	4.40
PW13	Power	Adhere to Established Best Practices for Installation/Removal Work	E-6.8.2	2.67	4.27
PW01	Power	Increase Emphasis on Operational Factors	E-1	3.07	4.13
PW08	Power	Adhere to Established Best Practices for DC Plants	E-6.4.1	3.50	4.13
PW14	Power	Maintain & Exercise Site-Specific Procedures	E-6.9	2.53	4.07
PW23	Power	Power Expertise/Power Teams	E-6.13.1(9)	3.13	4.07
PW20	Power	Local Procedures and Contingency Plans for Power Emergencies	E-6.13.1(6)	2.33	4.00
PW21	Power	AC Tap Boxes Outside COs for Portable Engines	E-6.13.1(7)	3.73	4.00
PW03	Power	Adhere to Standards	E-6(3)	2.82	3.93
PW06	Power	Adhere to Established Best Practices for Standby Generators	E-6.2.2	3.30	3.93
PW07	Power	Adhere to Established Best Practices for Building AC Systems	E-6.3.1	3.43	3.93
PW11	Power	Employ Specialized Teams	E-6.7	3.53	3.93
PW15	Power	Put Standby Engines Online Before Power Fails in Storms	E-6.13.1(1)	2.20	3.91
PW17	Power	Improve Fuel Systems Reliability: Design & Maintenance	E-6.13.1(3)	2.67	3.86
PW16	Power	Design Standby Systems for Wind and Rain in Coastal Areas	E-6.13.1(2)	2.69	3.82
PW19	Power	Automatic AC Transfer Switches Instead of Paired Circuit Breakers	E-6.13.1(5)	3.15	3.82
PW22	Power	Remote Power Monitors	E-6.13.1(8)	3.53	3.79
PW09	Power	Adhere to Established Best Practices for DC Distribution Systems	E-6.4.1	3.30	3.73
PW24	Power	Fewer but Larger DLC RTs with Bulk Power	E-6.13.2(1)	3.36	3.45
PW04	Power	Coordinate with Electric Utilities	E-6.1, 6.13.2(4)	2.00	3.43
PW25	Power	Security of Portable Generators	E-6.13.2(2)	2.64	3.25

## Best Practices Recommendations Sorted by Decreasing Average Effectiveness Rating

ID	Focus Team	Recommendation	June 1993 Report Reference	Average Rating	
				Cost	Effectiveness
PW05	Power	Adhere to Established Best Practices for Commercial Power	E-6.1.9	2.53	3.21
PW18	Power	Automatic Reserve Lubrication Oil Makeup Systems	E-6.13.1(4)	3.00	3.18
PW26	Power	Diesel Portable Generators	E-6.13.2(3)	3.62	3.09
ES01	E911	50% of 911 Circuits Provisioned on Each of Two Diverse Interoffice Facilities	F-6.1.1, Fig. 6-2	3.39	4.40
ES20	E911	Diverse ALI Database Systems	F-6.5, Fig. 6-14	3.89	4.11
ES02	E911	Automatic Switching of 911 Circuits to a Diverse Standby Protection Facility	F-6.1.1	3.40	4.00
ES04	E911	Fiber Ring Topologies for 911 Circuits	F-6.1.1.1, Fig. 6-4	4.50	3.78
ES03	E911	Diverse Interoffice Facilities from Customer End Office Home onto Two Diverse DCSs	F-6.1.1, Fig. 6-3	3.70	3.71
ES19	E911	911 Network Management Center & Procedures to Manage and Prioritize Repairs	F-6.4	3.50	3.60
ES08	E911	Public Switched Network as Back-up for 911 Dedicated Trunks	F-6.1.3.3, Fig. 6-9	2.80	3.57
ES17	E911	Evaluate Trend toward Increased Concentration of 911 Capabilities	F-1.3, 6.2	3.89	3.57
ES06	E911	Alternate PSAPs off the 911 Tandem Switch	F-6.1.3.1, Fig. 6-7	3.30	3.56
ES22	E911	Pre-planning and Cooperation to Minimize Effects of Mass Calling Events	F-6.6	1.90	3.43
ES18	E911	Local Loop Diversity for Larger PSAPs	F-6.3	4.05	3.33
ES23	E911	Contingency Plan Development for Emergency 911 Service	F-6.7.1	2.70	3.30
ES16	E911	Operator Services Tandem as Backup for 911	F-6.1.3.2, Fig. 6-8	3.30	3.29
ES07	E911	Alternate PSAPs off the End Office	F-6.1.3.1, Fig. 6-7	3.10	3.25
ES14	E911	Diverse Paired 911 Tandem Switches	F-6.2.1	4.27	3.25
ES26	E911	Improve Communications Among LECs, Administrators & Public Safety Agencies	F-1.3	2.20	3.25
ES12	E911	Two 911 Tandems to Serve a Single Customer and the PSAP	F-6.1.2.1, 6.2.1, Fig. 6-5	4.70	3.22
ES24	E911	Contingency Plan Training for Emergency 911 Service	F-6.7.1	2.50	3.22
ES15	E911	Multiple Diverse 911 Tandem Switches with Paired Diverse DCSs	F-6.2.2, Fig. 6-6	4.60	3.17
ES21	E911	Move Mass Calling Stimulator Away from 911 Tandem Switch	F-6.6, Fig. 6-15	2.40	3.14
ES09	E911	Cellular Network as Back-up	F-6.1.3.4, Fig. 6-10	3.50	3.00
ES05	E911	Red-tagged, Diverse Equipment within a Central Office	F-6.1.4	1.80	2.89
ES25	E911	Public Education on Proper Use of 911 Service	F-6.7.1	2.90	2.89
ES10	E911	Intraoffice Call Termination to Mobile PSAP when Office is Isolated	F-6.1.3.5, Fig. 6-11	3.00	2.67
ES11	E911	Back-up PSAP Permanently Located Within the Central Office	F-6.1.3.5	4.10	2.60
ES13	E911	Re-homing to Back-up 911 Tandem Switch	F-6.1.2.2, 6.2.2, Fig. 6-6	4.45	2.60
ES27	E911	Defer Use of CCS Network Until Protocol Issues Addressed by Standards Bodies	F-1.3, 6.7	-	-
ES28	ECOMM	Redundancy/Diversity of Links from PSAP to Emergency Response Personnel	ECOMM Report 6.12		
ES29	ECOMM	Redundancy/Diversity of Links to Media and Network Repair Centers	ECOMM Report 6.13		
ES30	ECOMM	Private Switch/Alternative LEC ALI	ECOMM Report 6.14		
ES31	ECOMM	Commercial Mobile Radio Services Should Use 911 as Emergency Access Code	ECOMM Report 6.15		
ES31	ECOMM	Cable Television Providers Should Use NCTA Recommended Practices	ECOMM Report 6.16		

## Best Practices Recommendations Sorted by Decreasing Average Effectiveness Rating

ID	Focus Team	Recommendation	June 1993 Report Reference	Average Rating	
				Cost	Effectiveness
ES33	ECOMM	Uniform Method of Reporting and Tracking Significant Service Outages	ECOMM Report 6.17		
FR32	Fire	Provide All Critical Facilities with a Modern Smoke Detection System	G-8	3.60	4.53
FR34	Fire	Implement Early Smoke Detection and Appropriate Ventilation Systems	G-10	3.60	4.14
FR02	Fire	Verify Smoke/Heat Detection Capability	G-6.2.2	2.60	4.13
FR20	Fire	Assure Programs Exist for Alarm Testing	G-6.5.4	2.00	4.13
FR05	Fire	Use ANSI T1.311-1991 for COs	G-6.2.4	2.73	4.09
FR16	Fire	Prohibit Smoking in Buildings	G-6.4.3	1.60	4.08
FR19	Fire	Verify Grounding Arrangements	G-6.5.3	2.86	4.07
FR13	Fire	Develop & Execute a Standard MOP for Vendor Work	G-6.3.3	2.20	4.00
FR27	Fire	Use Over-current Protection Devices and Fusing	G-6.7.5	2.80	3.93
FR03	Fire	Meet NEBS Requirements for Power & Communication Cables	G-6.2.3A	2.93	3.93
FR33	Fire	Provide Automatic Notification of Local Fire Department	G-9	2.64	3.93
FR28	Fire	Inspect and Maintain HVAC areas	G-6.7.6	2.33	3.87
FR11	Fire	Use Defined Procedure for Cable Mining	G-6.3.1	2.08	3.83
FR31	Fire	Certified Inspection of Boilers & Fuel Storage Units	G-6.7.9	2.57	3.79
FR08	Fire	Locate Transformers External to Buildings	G-6.2.9	3.17	3.75
FR14	Fire	Develop Site Management & Building Certification Program	G-6.4.1, 6.6.1, 6.7.1	2.86	3.71
FR12	Fire	Implement a Certification & Training Program for Contractors	G-6.3.2	2.93	3.69
FR18	Fire	Provide AC Surge Protection	G-6.5.2	3.23	3.62
FR29	Fire	Restrict Use of Space Heaters	G-6.7.7	1.60	3.62
FR30	Fire	Establish Building Equipment Maintenance Program	G-6.7.8	2.80	3.60
FR26	Fire	Provide Smoke Detection and Ventilation in Motor Room	G-6.7.4	2.87	3.57
FR01	Fire	Develop Pre-plans with Fire Agencies	G-6.2.1	1.87	3.53
FR06	Fire	Test All Pre-1989 VRLA Batteries	G-6.2.5C	3.08	3.50
FR09	Fire	Regularly Inspect Motors	G-6.2.10	2.50	3.50
FR10	Fire	Exercise & Calibrate Circuit Breakers	G-6.2.11	3.00	3.46
FR23	Fire	Insure Proper Air Filtration	G-6.6.4	2.79	3.46
FR04	Fire	Consider Non-reuse of Noncompliant Cable	G-6.2.3B	2.79	3.38
FR07	Fire	Establish Case History File by Equipment Category for Rectifiers	G-6.2.7A	2.38	3.33
FR25	Fire	Verify Elevator Building Compartments Comply with Code	G-6.7.3	2.50	3.30
FR24	Fire	Administer Elevator Routines	G-6.7.2	2.29	3.23
FR15	Fire	Review Practices on Use of Soldering Irons	G-6.4.2	1.77	3.15
FR17	Fire	Verify Aerial Powerlines are Not in Conflict with Hazards	G-6.5.1	2.85	3.09
FR21	Fire	Avoid Use of Combustible Landscape Material	G-6.6.2	2.00	2.92
FR22	Fire	Verify Dumpster Location	G-6.6.3	2.00	2.83

## Best Practices Recommendations Sorted by Decreasing Average Effectiveness Rating

ID	Focus Team	Recommendation	June 1993 Report Reference	Average Rating	
				Cost	Effectiveness
SUP25	DCS	Improve Software Process	D-6.3	4.50	4.75
SUP13	DCS	Validate Upgrades in Lab Environment	D-6.1.2	3.75	4.63
SUP04	Signaling	Minimize Initialization Durations	B-5.2.4.5, 5.2.5.4.	3.50	4.60
SUP11	DCS	Collaboration on Root Cause Analysis	D-6.1.1	3.25	4.50
SUP12	DCS	Establish Core Team to Plan, Test and Evaluate Change Activities	D-6.1.2	3.50	4.50
SUP27	DCS	Deploy Systems with Redundant Disk Drives	D-6.4.1(c)	3.75	4.50
SUP08	Switch	Reduce Need for Scheduled Outages	C-5.2.3(1-4)	3.50	4.40
SUP29	DCS	Develop Redundant Controller Architecture	D-6.4.2(a)	4.25	4.38
SUP06	Signaling	Failure Data Collect. & Root Cause Analysis	B-6.1.1	2.33	4.20
SUP20	DCS	Include Troubleshooting Flowcharts in Documentation	D-6.2.4	4.00	4.13
SUP22	DCS	Develop Training for Customer Needs with Customer Testing	D-6.2.7	3.00	4.13
SUP23	DCS	Update Training as Product Evolves	D-6.2.8	3.25	4.13
SUP28	DCS	Improve Documentation on Backup & Recovery	D-6.4.1(d)	2.75	4.13
SUP07	Switch	Enhance System Defensiveness to Service Affecting Activity	C-5.1.3	3.83	4.00
SUP14	DCS	Eliminate Silent Failures	D-6.1.4, 6.1.8	3.75	4.00
SUP19	DCS	Develop Acceptance Testing Checkoff Sheet	D-6.2.4	2.50	4.00
SUP21	DCS	Use Human Factors Considerations in Documentation Development	D-6.2.5	3.50	4.00
SUP01	Signaling	Software Fault Insertion	B-5.2.4.5, 5.2.5.4.	2.67	3.80
SUP02	Signaling	Hardware Fault Insertion	B-5.2.4.5, 5.2.5.4.	2.67	3.80
SUP15	DCS	Establish Performance Levels	D-6.1.6	3.50	3.75
SUP26	DCS	Review Level of Inspection on Critical Components	D-6.4.1(a)	3.25	3.75
SUP05	Signaling	Place Added Emphasis on Human Factors Design	B-5.2.7.1.1	2.50	3.67
SUP16	DCS	Ensure Adequate Documentation	D-6.2.1, 6.2.2, 6.2.3	4.00	3.67
SUP24	DCS	Develop Training for Local & Centralized Tier 1/ 2 OAM&P Personnel	D-6.2.9, 6.2.10	3.50	3.63
SUP03	Signaling	Review of Fault Recovery Actions	B-5.2.4.5, 5.2.5.4.	2.67	3.60
SUP10	Switch	Enhance Software Development Methodology	C-5.4.3(1-10)	3.83	3.60
SUP17	DCS	Establish Change Control Database	D-6.2.3	3.50	3.50
SUP18	DCS	Document System Overview & Procedures	D-6.2.4	2.75	3.50
SUP09	Switch	Hardware & Software Fault Recovery Design Convergence	C-5.3.3(5-6))	3.60	3.25

## Appendix 6

### **Service Provider Best Practices Classified by Category**

**APPENDIX 6  
CATEGORIZATION OF SERVICE PROVIDER BEST PRACTICES**

ID	Focus Team	Recommendation	Purple Book Reference					
				Prevent Mitigate (P,M)	Focus (I,E)	Type (D,G,O)	Where (P,F)	App. (U,L)
FB01	Fiber	Adherence to Procedures	A-6.1.3	P	I	D	F	U
FB02	Fiber	Warning Tape	A-6.1.3	P	I	O	F	L
FB03	Fiber	Visible Cable Marking	A-6.1.3	P	I	O	F	U
FB04	Fiber	Respond to Locate Requests	A-6.1.3	P	I	G	P	U
FB05	Fiber	Accurate Locates	A-6.1.3	P	I	D	P	U
FB06	Fiber	Enhanced Locating Equipment	A-6.1.3	P	I	G	P	U
FB07	Fiber	Use of Plant Route Maps	A-6.1.3	P	I	G	P	U
FB08	Fiber	Hand Dig in Safety Zone	A-6.1.3	P	I	O	P	U
FB09	Fiber	Technician Supervision	A-6.1.3	P	I	G	P	U
FB10	Fiber	On-Line Technical Support	A-6.1.3	P	I	G	P	U
FB11	Fiber	Cooperation With Contractors	A-6.1.3	P	E	D	P	U
FB12	Fiber	Training	A-6.1.3	P	I	D	P	U
FB13	Fiber	Contractor Awareness	A-6.1.3	P	E	G	P	U
FB14	Fiber	Contact With Land Owners	A-6.1.3	P	E	G	P	U
FB15	Fiber	Patrol Cable Routes	A-6.1.3	P	I	G	P	U
FB16	Fiber	Audits/Surveys of Plant	A-6.1.3	P	I	G	P	U
FB17	Fiber	Barriers	A-6.1.3	P	I	G	F	L
FB18	Fiber	Buried Cable	A-6.1.3	P	I	G	F	U
FB19	Fiber	Buried Facilities	A-6.1.3	P	I	G	F	U

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CATEGORIZATION OF SERVICE PROVIDER BEST PRACTICES**

ID	Focus Team	Recommendation	Purple Book Reference					
				Prevent Mitigate (P,M)	Focus (I,E)	Type (D,G,O)	Where (P,F)	App. (U,L)
FB20	Fiber	Shielding	A-6.1.3	P	I	G	F	U
FB21	Fiber	Protective Devices	A-6.1.3	P	I	G	F	L
FB22	Fiber	Stronger Conduit	A-6.1.3	P	I	G	F	L
FB23	Fiber	Separate Pole Lines	A-6.1.3	P	I	G	F	U
FB24	Fiber	No Visible Markings	A-6.1.3	P	I	G	F	L
FB25	Fiber	Secured Manholes	A-6.1.3	P	I	G	F	L
FB26	Fiber	Ventilate Manholes	A-6.1.3	M	I	G	F	L
SN01	SNS	Awareness Training Program	B-5.2.4.5	P	I	G	P	U
SN02	SNS	Architectural Alternatives	B-5.2.4.5	P	I	D	F	U
SN03	SNS	Off-Peak Scheduling	B-5.2.4.5	P	I	G	P	U
SN04	SNS	STP Maintenance Personnel Training	B-5.2.5.4	P	I	G	P	U
SN05	SNS	Evaluation & Periodic Maintenance of SCP UPS	B-5.2.6.2	P	I	G	P	U
SN06	SNS	Place SCPs in CO Environment	B-5.2.6.2	P	I	D	F	U
SN07	SNS	Maintain A-Link Diversity	B-5.2.7.1.1, 6.2.1	P	I	G	P	U
SN08	SNS	Review Rehome Procedures	B-5.2.8	P	I	G	P	U
SN09	SNS	Review Detection & Manual Intervention Procedures	B-5.2.8	M	I	G	P	U
SN10	SNS	Training in Trouble Detection & Isolation	B-5.2.8	M	I	G	P	U
SN11	SNS	Training in Power Equipment Maintenance	B-5.2.8	P	I	G	P	U
SN12	SNS	Failure Data Collect. & Root Cause Analysis	B-6.1.1	P	I	D	P	U

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CATEGORIZATION OF SERVICE PROVIDER BEST PRACTICES**

ID	Focus Team	Recommendation	Purple Book Reference					
				Prevent Mitigate (P,M)	Focus (I,E)	Type (D,G,O)	Where (P,F)	App. (U,L)
SN13	SNS	Signaling Information Sharing	B-6.1.2	P	E	D	P	U
SN14	SNS	Evaluate TIRKS Enhancements	B-6.2.1.4	P	E	G	F	U
SN15	SNS	Develop Crisis Management Exercises	B-6.2.2	M	E	D	P	U
SW01	SW	Failure Data Collection & Root Cause Analysis	C-5.1.3, 5.2.3, 5.3.3	P	I	D	P	U
SW02	SW	MOP for Hardware & Software Growth	C-5.1.3(3)	P	I	G	P	U
SW03	SW	Establish Manual System Reinitialization Procedures	C-5.1.3(4)	P	I	G	P	U
SW04	SW	Establish Objectives for Number of Scheduled Outages	C-5.2.3	P	I	O	P	L
SW05	SW	Reduce Requirements Need for Scheduled Outages	C-5.2.3(5)	P	E	D	P	U
SW06	SW	Coordinate Reinitializations & Improve Manual Procedures	C-5.2.3(6-7)	P	I	D	P	U
SW07	SW	Implement New Requirements	C-5.5.3(3)	P	E	D	F	U
SW08	SW	Negotiate Service Provider - Network Provider Reliability Agreements	C-5.5.3(4)	P	E	D	P	U
DX01	DCS	Institute DCS Awareness Program	D-6.1.1	P	I	G	P	U
DX02	DCS	Emulate Switching Environment for DCSs	D-6.1.1	P	I	G	P	U
DX03	DCS	Collaboration on Root Cause Analysis	D-6.1.1	P	E	G	P	U
DX04	DCS	Establish Core Team to Plan, Test and Evaluate Change Activities	D-6.1.2	P	I	G	P	U
DX05	DCS	Validate Upgrades in Lab Environment	D-6.1.2	P	I	G	P	U
DX06	DCS	Establish Standard Parameters & Office Settings	D-6.1.2	M	I	G	P	U
DX07	DCS	Validate New Procedures & Commands	D-6.1.2	P	I	G	P	U
DX08	DCS	Establish "Change Management" Group	D-6.1.2	P	I	D	P	U

**APPENDIX 6  
CATEGORIZATION OF SERVICE PROVIDER BEST PRACTICES**

ID	Focus Team	Recommendation	Purple Book Reference					
				Prevent Mitigate (P,M)	Focus (I,E)	Type (D,G,O)	Where (P,F)	App. (U,L)
DX09	DCS	Restrict Commands Available to Technicians	D-6.1.3	P	I	G	P	U
DX10	DCS	Ensure Facility & DCS Databases in Sync	D-6.1.3	P	I	G	P	U
DX11	DCS	Develop Procedures for Manual Provisioning	D-6.1.3	M	I	G	P	U
DX12	DCS	Initiate Procedures to Review Passwords	D-6.1.3	P	I	G	P	U
DX13	DCS	Use Callback Modems ( * It is recommended that this no longer be included)	D-6.1.3	*	*	*	*	*
DX14	DCS	Establish Procedure to Uninhibit Alarms after Provisioning	D-6.1.3	P	I	G	P	U
DX15	DCS	Provide Capacity to Process Alarms & Control the DCS	D-6.1.4	M	I	G	F	U
DX16	DCS	For Service Restoration, Provide Fully Redundant Communication Links	D-6.1.4	M	I	G	F	U
DX17	DCS	Eliminate Silent Failures	D-6.1.4, 6.1.8	M	I	G	F	U
DX18	DCS	Establish Centralized Support Organization	D-6.1.5	P	I	G	P	U
DX19	DCS	Establish Performance Levels	D-6.1.6	P	E	G	F	U
DX20	DCS	Establish Disaster Recovery Plans	D-6.1.7	M	I	G	P	U
DX21	DCS	Failure Data Collection & Root Cause Analysis	D-6.1.7,7	P	I	G	P	U
DX22	DCS	Schedule System Backups	D-6.1.8	M	I	G	P	U
DX23	DCS	Ensure Adequate Documentation	D-6.2.1, 6.2.2, 6.2.3	P	I	D	P	U
DX24	DCS	Document System Overview & Procedures	D-6.2.4	P	I	D	P	U
DX25	DCS	Develop Acceptance Testing Checkoff Sheet	D-6.2.4	P	I	G	P	U
DX26	DCS	Include Troubleshooting Flowcharts in Documentation	D-6.2.4	P	I	G	P	U
DX27	DCS	Use Human Factors Considerations in Documentation Development	D-6.2.5	P	I	G	P	U

**APPENDIX 6  
CATEGORIZATION OF SERVICE PROVIDER BEST PRACTICES**

ID	Focus Team	Recommendation	Purple Book Reference					
				Prevent Mitigate (P,M)	Focus (I,E)	Type (D,G,O)	Where (P,F)	App. (U,L)
DX28	DCS	Institute DCS Technician Certification Programs	D-6.2.11	P	I	G	P	U
DX29	DCS	Have Sufficient Spares	D-6.4.1(b)	M	I	G	F	U
DX30	DCS	Deploy Systems with Redundant Disk Drives	D-6.4.1(c)	P	I	G	F	U
DX31	DCS	Insist on Suppliers Providing Reliability Data to Prove Designs Meet Network Criteria	D-6.4.2(b)	P	E	D	P	U
DX32	DCS	Revisit Reliability Requirements & Reallocate Failure Rates	D-6.5.1, 6.5.2	P	I	D	P	L
DX33	DCS	Revisit DCS Sizing	D-6.5.4	P	I	D	F	L
PW01	Power	Increase Emphasis on Operational Factors	E-1	P	I	D	P	U
PW02	Power	Eliminate Single Points of Failure	E-6(2)	P	I	G	F	U
PW03	Power	Adhere to Standards	E-6(3)	P	I	G	F	U
PW04	Power	Coordinate with Electric Utilities	E-6.1, 6.13.2(4)	P	E	D	P	U
PW05	Power	Adhere to Established Best Practices for Commercial Power	E-6.1.9	P	E	O	P	U
PW06	Power	Adhere to Established Best Practices for Standby Generators	E-6.2.2	M	I	O	P	U
PW07	Power	Adhere to Established Best Practices for Building AC Systems	E-6.3.1	M	I	D	F	U
PW08	Power	Adhere to Established Best Practices for DC Plants	E-6.4.1	M	I	O	F	U
PW09	Power	Adhere to Established Best Practices for DC Distribution Systems	E-6.4.1	M	I	O	F	U
PW10	Power	Adhere to Established Best Practices for Alarms & Remote Monitoring	E-6.6.4	M	I	D	P	U
PW11	Power	Employ Specialized Teams	E-6.7	P	I	G	P	U
PW12	Power	Adhere to Established Best Practices for Operations & Maintenance	E-6.7.1	P	I	G	P	U
PW13	Power	Adhere to Established Best Practices for Installation/Removal Work	E-6.8.2	P	I	G	P	U

**APPENDIX 6  
CATEGORIZATION OF SERVICE PROVIDER BEST PRACTICES**

ID	Focus Team	Recommendation	Purple Book Reference					
				Prevent Mitigate (P,M)	Focus (I,E)	Type (D,G,O)	Where (P,F)	App. (U,L)
PW14	Power	Maintain & Exercise Site-Specific Procedures	E-6.9	P	I	D	P	U
PW15	Power	Put Standby Engines Online Before Power Fails in Storms	E-6.13.1(1)	P	I	G	P	L
PW16	Power	Design Standby Systems for Wind and Rain in Coastal Areas	E-6.13.1(2)	P	I	D	F	L
PW17	Power	Improve Fuel Systems Reliability: Design & Maintenance	E-6.13.1(3)	P	I	G	F	U
PW18	Power	Automatic Reserve Lubrication Oil Makeup Systems	E-6.13.1(4)	P	I	G	F	U
PW19	Power	Automatic AC Transfer Switches Instead of Paired Circuit Breakers	E-6.13.1(5)	P	I	G	F	U
PW20	Power	Local Procedures and Contingency Plans for Power Emergencies	E-6.13.1(6)	P	I	D	P	U
PW21	Power	AC Tap Boxes Outside COs for Portable Engines	E-6.13.1(7)	M	I	G	F	U
PW22	Power	Remote Power Monitors	E-6.13.1(8)	P	I	D	F	U
PW23	Power	Power Expertise/Power Teams	E-6.13.1(9)	P	I	G	P	U
PW24	Power	Fewer but Larger DLC RTs with Bulk Power	E-6.13.2(1)	P	I	G	F	U
PW25	Power	Security of Portable Generators	E-6.13.2(2)	M	I	G	P	U
PW26	Power	Diesel Portable Generators	E-6.13.2(3)	M	I	G	F	U
FR01	Fire	Develop Pre-plans with Fire Agencies	G-6.2.1	M	E	D	P	U
FR02	Fire	Verify Smoke/Heat Detection Capability	G-6.2.2	M	I	D	P	U
FR03	Fire	Meet NEBS Requirements for Power & Communication Cables	G-6.2.3A	P	I	G	F	U
FR04	Fire	Consider Non-reuse of Noncompliant Cable	G-6.2.3B	P	I	D	F	U
FR05	Fire	Use ANSI T1.311-1991 for COs	G-6.2.4	P	I	G	F	U
FR06	Fire	Test All Pre-1989 VRLA Batteries	G-6.2.5C	P	I	G	P	U

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FR07	Fire	Establish Case History File by Equipment Category for Rectifiers	G-6.2.7A	P	I	G	P	U
FR08	Fire	Locate Transformers External to Buildings	G-6.2.9	M	I	D	F	U
FR09	Fire	Regularly Inspect Motors	G-6.2.10	P	I	G	P	U
FR10	Fire	Exercise & Calibrate Circuit Breakers	G-6.2.11	P	I	G	P	U
FR11	Fire	Use Defined Procedure for Cable Mining	G-6.3.1	P	E	G	P	U
FR12	Fire	Implement a Certification & Training Program for Contractors	G-6.3.2	P	E	G	P	U
FR13	Fire	Develop & Execute a Standard MOP for Vendor Work	G-6.3.3	P	E	G	P	U
FR14	Fire	Develop Site Management & Building Certification Program	G-6.4.1, 6.6.1, 6.7.1	P	I	D	P	U
FR15	Fire	Review Practices on Use of Soldering Irons	G-6.4.2	P	I	G	P	U
FR16	Fire	Prohibit Smoking in Buildings	G-6.4.3	P	I	D	P	U
FR17	Fire	Verify Aerial Powerlines are Not in Conflict with Hazards	G-6.5.1	P	E	G	P	U
FR18	Fire	Provide AC Surge Protection	G-6.5.2	P	I	G	F	U
FR19	Fire	Verify Grounding Arrangements	G-6.5.3	P	I	G	F	U
FR20	Fire	Assure Programs Exist for Alarm Testing	G-6.5.4	M	I	G	P	U
FR21	Fire	Avoid Use of Combustible Landscape Material	G-6.6.2	P	I	D	P	U
FR22	Fire	Verify Dumpster Location	G-6.6.3	P	I	G	P	U
FR23	Fire	Insure Proper Air Filtration	G-6.6.4	P	I	G	F	U
FR24	Fire	Administer Elevator Routines	G-6.7.2	P	I	G	P	U
FR25	Fire	Verify Elevator Building Compartments Comply with Code	G-6.7.3	P	I	G	P	L

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ID	Focus Team	Recommendation	Purple Book Reference					
				Prevent Mitigate (P,M)	Focus (I,E)	Type (D,G,O)	Where (P,F)	App. (U,L)
FR26	Fire	Provide Smoke Detection and Ventilation in Motor Room	G-6.7.4	P	I	G	F	U
FR27	Fire	Use Over-current Protection Devices and Fusing	G-6.7.5	P	I	G	F	U
FR28	Fire	Inspect and Maintain HVAC areas	G-6.7.6	P	I	G	P	U
FR29	Fire	Restrict Use of Space Heaters	G-6.7.7	P	I	G	P	U
FR30	Fire	Establish Building Equipment Maintenance Program	G-6.7.8	P	I	G	P	U
FR31	Fire	Certified Inspection of Boilers & Fuel Storage Units	G-6.7.9	P	E	G	F	U
FR32	Fire	Provide All Critical Facilities with a Modern Smoke Detection System	G-8	M	I	D	F	U
FR33	Fire	Provide Automatic Notification of Local Fire Department	G-9	M	I	D	F	U
FR34	Fire	Implement Early Smoke Detection and Appropriate Ventilation Systems	G-10	M	I	D	F	U

