ENGINEERING GUIDELINES FOR THE EVALUATION OF HYDROPOWER PROJECTS

CHAPTER 16 – PART 12D PROGRAM

DRAFT FOR PUBLIC COMMENT

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ABBREVIATIONS

CA	Comprehensive Assessment
CAR	Comprehensive Assessment Report
CFR	Code of Federal Regulations
Commission	Federal Energy Regulatory Commission
D2SI	Division of Dam Safety and Inspections
DSPMP	Dam Safety Performance Monitoring Program
DSSMP	Dam Safety Surveillance and Monitoring Plan
DSSMR	Dam Safety Surveillance and Monitoring Report
EAP	Emergency Action Plan
FAAP	FERC After Action Panel
FERC	Federal Energy Regulatory Commission
FERC-RO	Regional Office (of the FERC, D2SI)
FERC-WO	Washington Office (of the FERC, D2SI)
FPC	Federal Power Commission
Guidelines	FERC Engineering Guidelines for the Evaluation of Hydropower Projects
IC	Independent Consultant
IC Team	Independent Consultant Team
IDF	Inflow Design Flood
IFT	Independent Forensic Team
Part 12D	18 CFR Part 12, Subpart D
PFM	Potential Failure Mode
PFMA	Potential Failure Modes Analysis
PI	Periodic Inspection
PIR	Periodic Inspection Report
PIPR	Pre-Inspection Preparation Report
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
RA	Risk Analysis
RAR	Risk Analysis Report
STID	Supporting Technical Information Document

DEFINITIONS

Part 12D Inspection: an inspection performed to fulfill the requirements for an inspection by an Independent Consultant, as defined in 18 CFR § 12.31(a). This term may refer to either a Periodic Inspection (PI), Comprehensive Assessment (CA), or an inspection conducted in accordance with the rules established by Federal Power Commission (FPC) Order 315 or Federal Energy Regulatory Commission (FERC) Order 122. Whether the term “Part 12D Inspection” refers to a PI, a CA, or inspection in accordance with the rules established by FPC Order 315 or FERC Order 122 can be determined from the context in which it is used.

Part 12D Report: the report on a Part 12D Inspection (i.e., a Comprehensive Assessment Report, a Periodic Inspection Report, or a report on an inspection in accordance with the rules established by FPC Order 315 or FERC Order 122).

Note: all references to "Licensee" in this chapter are also applicable to Exemptees.

PREFACE

Prior to the issuance of this chapter of the Guidelines, FERC-issued guidance related to the performance of Part 12D Inspections was limited in scope and detail. The majority of the information was provided as an appendix to Chapter 14 and in the project-specific Part 12D Inspection reminder letter from the D2SI-Regional Engineer to the licensee. This chapter consolidates and expands on that information and incorporates several findings and recommendations of the Oroville Independent Forensic Team (IFT) and FERC After-Action Panel (FAAP).

The FERC strongly recommends that all parties involved in dam safety read the Oroville IFT and FAAP Reports in their entirety and carefully consider their contents and lessons learned. Both reports are available on the FERC website. Several passages from each have been reproduced below (**emphasis added**) along with commentary on the D2SI interpretation and application of these comments in enhancing the Part 12D Program.

Need for Comprehensive Reviews

Both the IFT and the FAAP identified issues regarding the general understanding of the scope of a Part 12D Inspection:

> "Periodic **comprehensive reviews of original design and construction and subsequent performance** are imperative. These reviews should be **based on complete records** and need to be **more in-depth than periodic general reviews**, such as the current FERC-mandated five-year reviews."[1]

> "…the **Part 12D regulations and other published guidance from FERC have been somewhat ambiguous regarding whether the Part 12D reports were intended to be 'updates' on changes since the prior five-year report, versus relatively comprehensive reviews** of the facilities which evaluated their design, construction, condition, and performance history relative to current states of the practice."[2]

> "…**certain aspects** of [Oroville Part 12D] reviews **were treated as merely updates** of existing information, **rather than an independent checking of facts** and a thorough review of available information and analyses…"[3]

This chapter of the Guidelines clearly states that each Part 12D Inspection and Part 12D Report is to be an independent assessment. It is not permitted to rely entirely on previous

[1] IFT Report, page S-3.
[2] IFT Report, page K2-5.
[3] FAAP Report, page 30.

interpretations; critical evaluation is required and must be thoroughly documented for each Part 12D Inspection.

Importance of Reviewing Original Design and Construction Records, Analyses of Record, Comparing to Current Practices, and Performing Independent Calculations

Both the IFT and FAAP identified several instances in which there was an apparent lack of critical information due to a reliance on summaries of information – in the Supporting Technical Information Document (STID), Potential Failure Modes Analysis (PFMA), Part 12D Report, or elsewhere – that mischaracterized the original content, even by something as simple as the omission of two introductory words. The deference to summaries and lack of review of original documents contributed to an overestimation of the resiliency of the Oroville spillway structure:

> "Although the **poor foundation conditions at both spillways were well documented** in geology reports, **these conditions were not properly addressed** in the original design and construction, **and all subsequent reviews mischaracterized the foundation as good quality rock**."[4]

Similarly, the FAAP noted the following with respect to the implementation of the Part 12D program with respect to Oroville Dam:

> "**There was an overall lack of rigor in the performance of the Part 12 review and their follow up**. Too much emphasis seems to have been placed on the process and not enough on detailed engineering reviews aimed at understanding the performance of critical structures."[5]

The FAAP provided examples of this, including:[6]

- an "**over reliance on previous analyses** without reviewing whether such analyses were appropriately representative and used tools and methods that would satisfy current (at the time of evaluation) state of the art"
- and "the **apparent contradiction between the poor geology actually mapped along the spillway chute** during construction, **and the statements in the Part 12 and PFMA reports that the rock along the spillway chute was very competent**."

[4] IFT Report, page S-2.
[5] FAAP Report, page 41.
[6] FAAP Report, page 41.

Both the IFT and FAAP commented on the need to perform a comprehensive review of the design and construction, with comparison to as-built conditions and current best practices:

> "The IFT believes that comprehensive and detailed reviews of older designs against current best practices for design and construction are required."[7]
>
> "FERC Engineering Guidelines for the Part 12 process specifically dictate that the IC should review all available analyses and determine as to whether or not the summary of those analyses contained in the STID are accurate and sufficient for use by the owner during operation of the project. Apparently, **no efforts were made to review original design calculations and intent** and compare them with as built conditions, **opting instead to accept past Part 12 descriptions and summary of results as adequate**. The FAAP notes that this was apparently also the case at Wanapum Dam in Washington state a few years ago."[8]

In the case of Wanapum Dam, a simple hand calculation, whether completed by the licensee, IC, or the FERC, could have been able to identify the lift line stability issue and allow it to be addressed before progressing to the point of permanent displacement.

The regulations incorporate these enhancements recommended by the IFT and FAAP.

Surveillance and Monitoring Data and Operations and Maintenance Programs

Both the IFT and the FAAP noted the high flows from Oroville spillway chute drains and repeated repairs of herringbone cracks in the slab, and expressed concern that these observations were never treated as indicative of adverse performance. Instead, conditions that should have been considered as unexpected behavior became the accepted condition due to repeated occurrence and lack of adverse consequence.

This concept has been referred to as the "normalization of deviance," which the IFT noted "**was being perpetuated by blindly building on previous reports.**"[9] The FAAP Report noted that there was a "**lack of urgency/concern about the very large outflows from the spillway chute drains** throughout its operational life."[10]

The following passage further illustrates this point:

[7] IFT Report, page F2-14.
[8] FAAP Report, pages 30-31.
[9] IFT Report, page F2-14
[10] FAAP Report, page 41.

> "…physical inspections are typically visual inspections from accessible locations and do not directly provide insight into latent conditions which cannot be detected by visual inspection. For the Oroville Dam service spillway, the observed slab cracking and the drain flows had become accepted by DWR, DSOD, FERC, and external consultants as "normal" conditions, and the slab details which increased its vulnerability to failure went unnoticed. As long as the physical inspections revealed no detected change in the observed conditions, no concerns were identified."[11]

In addition, the IFT noted that the owner had performed repairs to the spillway chute multiple times with varying degrees of success. In some cases, the repairs were not coordinated with regulators in advance, so there was less of an opportunity to review the underlying causes that necessitated the repairs.

> "The repairs which deteriorated in as little as a few years after completion posed risks of increasing leakage into the foundations, increasing uplift pressures, and possibly creating vertical projections into the flow at spalls… it was not understood that development of deterioration of concrete in new areas, not just in previously repaired areas, was an indication of… continued degradation of the condition of the slab.
>
> The chute repairs which DWR performed in 2009 and 2013 were viewed as "routine maintenance" and not submitted to the regulators for review and approval."[12]

All parties involved in Part 12D Inspections must make a conscious effort to ensure they are not perpetuating mistaken assumptions or incorrect interpretations of information. Each inspection requires a detailed, independent review and evaluation of information.

Importance of Potential Failure Modes Analysis and Risk Analysis

The Oroville IFT noted that "shortcomings of the current [PFMA] processes in dealing with complex systems must be recognized and addressed. A critical review of these processes in dam safety is warranted."[13] Similarly, the FAAP noted that:

> "A contributing factor was an apparent **lack of recognition and appreciation of the probability and consequences (i.e., risk) in the evaluation of** the FCO [flood control outlet] chute and ES [emergency spillway] **failure modes and a lack of rigor in reviewing existing project documents**…**the potential failure of the FCO chute was dismissed due to an assumed low probability of occurrence** because it was founded 'on solid rock', although construction data,

[11] IFT Report, page 75.
[12] IFT Report, pages 52-53.
[13] IFT Report, page S-2.

> including photographs, documented the presence of shear zones and erodible clay material below the chute slab. Similarly, **the potential for failure of the Emergency Spillway** and the impact of potential erosion **was repeatedly dismissed outright**, based on the assumption that this structure would be used only in the rarest of circumstances (i.e., very low probability) but not necessarily a low risk event, as amply demonstrated."[14]

The regulations formally incorporate a PFMA and Risk Analysis (RA) into the scope of a Comprehensive Assessment (CA), and this chapter of the Guidelines provides details with respect to the performance of those activities during a CA.

[14] FAAP Report, pages 42-43.

16-1 INTRODUCTION

16-1.1 Purpose

The purpose of this chapter of the Engineering Guidelines for the Evaluation of Hydropower Projects is to establish the expectations associated with the performance of Periodic Inspections (PIs) and Comprehensive Assessments (CAs), and the contents and format of reports thereon. This Guideline assumes that the reader has an understanding of the regulations that establish the Commission's program for inspections by an Independent Consultant (IC).

16-1.2 Applicability

The guidance in this chapter is applicable to any Periodic Inspection or Comprehensive Assessment performed, and the report on it filed, to fulfill the requirements defined in 18 CFR Part 12, Subpart D.

16-1.3 History of the Part 12D Independent Consultant Inspection Program

FPC Order 315

The Part 12D Independent Consultant inspection program began in 1965 after Federal Power Commission (FPC) Order 315. The initial reports were relatively short and in many cases reiterated the design basis. Subsequent reports mostly repeated or referenced information contained in previous reports.

FERC Order 122

As part of the reorganization of the Department of Energy in 1977, the Federal Energy Regulatory Commission was chartered and replaced the FPC. In 1981, FERC Order 122 superseded FPC Order 315 and revised the procedures related to Independent Consultant inspections. Subsequent enhancements to the program included the addition of a Potential Failure Modes Analysis (PFMA) and development of the Supporting Technical Information Document (STID) in the early 2000s.

FERC Order XYZ

FERC Order XYZ superseded FERC Order 122 and established new regulations for Part 12D Inspections. This chapter was developed to provide context and additional details regarding the Part 12D Program.

16-1.4 Structure of this Guideline

This Guideline has been structured so a person interested in the requirements for a PI does not have to refer to sections related strictly to a CA (and vice versa). While this resulted in some redundancy in the Guideline, since there is some overlap between the two types of inspections, it was intentional for the purpose of usability. Table 1 indicates

the portions of the Guideline that contain information relevant to each type of inspection (PI or CA).

Table 1: Sections of this Guideline Relevant to a PI or CA

Section/Appendix	Topic	Periodic Inspection	Comprehensive Assessment
Section 16-2	Overview of the Part 12D Program	X	X
Section 16-3	Independent Consultants, Independent Consultant Teams, and Part 12D Inspection Plans	X	X
Section 16-4	Pre-Inspection Preparation Reports	X	X
Section 16-5	Periodic Inspections	X	
Section 16-6	Comprehensive Assessments		X
Section 16-7	Follow-up and Corrective Measures	X	X
Appendix 16-A	Outline for the Part 12D Inspection Plan	X	X
Appendix 16-B	Outline for the Periodic Inspection Report	X	
Appendix 16-C	Outline for the PI Pre-Inspection Preparation Report	X	
Appendix 16-D	Outline for the Comprehensive Assessment Report		X
Appendix 16-E	Outline for the CA Pre-Inspection Preparation Report		X
Appendix 16-F	Outline for the CA Review Meeting Presentation		X

16-2 OVERVIEW OF THE PART 12D PROGRAM

This section provides a general overview of the FERC's Part 12D Inspection Program.

16-2.1 Part 12D Inspection Timeline

Table 2 and Table 3, which are included at the end of this section, show the typical timelines for a PI and a CA, respectively. In each of the tables, the left column shows tasks or submittals that are the licensee's responsibility; the right column shows those that are the Commission's responsibility; and the middle shows the due date or approximate timing. For the purposes of this Guideline, the phrase "first IC Team activity" refers to a PFMA, RA, site/field inspection, or other activity that requires the participation of the complete IC Team.

16-2.1.1 Typical Cycle

As described in 18 CFR § 12.40, a CA is typically due once every ten years. A PI is typically due five years after a CA. This maintains the five-year interval for a Part 12D inspection that existed prior to Commission Order ####.

The sequential numbering of Part 12D Inspections shall be maintained – for example, a project that had its Seventh Part 12D Inspection in 2017 would have its Eighth Part 12D Inspection, either a PI or a CA, in 2022.

16-2.1.2 Variations

There may be cases where a project is subject to a Part 12D inspection more often or less often than once per five years. Some situations that may result in variations to the typical cycle include:

- During the initial implementation of the YYYY revisions to the Part 12D program;
- At the request of the licensee due to workload balance, major studies or remediation designs subject to a Board of Consultants review, etc.; or
- During or following a major dam safety incident.

Any licensee requesting a variation to the typical cycle must submit a request to the D2SI Regional Engineer. No variation may take effect without the written authorization of the D2SI Regional Engineer.

16-2.1.3 Waivers

Depending on the facts and conditions associated with a project – including the hazard potential, risk, and the reason it is subject to the Part 12D Program – the Regional Engineer may grant a waiver from the requirement that a CA be performed once every ten years. This will be evaluated on a case-by-case basis by the Regional Engineer, in consultation with the Director, D2SI. **Any requests by a licensee to obtain a blanket waiver from performing a Comprehensive Assessment, without having performed**

one previously to provide a full understanding of the project, will not be considered. The FERC understands that some remote projects have extremely low consequences and CAs on a ten-year cycle may not be necessary; however, the FERC does not intend to provide such a waiver without the full understanding provided by the initial CA.

16-2.2 Part 12D Inspection Plan

Licensees must submit a detailed Part 12D Inspection Plan that describes the scope of the inspection, proposes an Independent Consultant Team, and establishes the proposed schedule. Details regarding the Part 12D Inspection Plan are provided in Section 16-3.

Independent Consultant Team (IC Team)

The Part 12D Inspection Plan must include the proposed Independent Consultants and other roles required for the project and type of Part 12D Inspection being performed. Collectively, the ICs and supporting team members are referred to as the IC Team.

16-2.3 IC Team's Pre-Inspection Preparation Report

The IC Team must prepare a Pre-Inspection Preparation Report (PIPR) to document their initial findings from their review of project documentation, instrumentation data, and other information prior to the first IC Team activity (i.e., the field inspection, PFMA, or RA, as applicable). Details regarding the scope and content of the PIPR are included in Section 16-4. The format of the PIPR generally follows that of the corresponding Part 12D Inspection Report.

16-2.4 Part 12D Inspections and Reports

16-2.4.1 Periodic Inspection

The PI is a performance-focused evaluation that includes, but is not limited to, the following components:

- A review of relevant background material;
- A field inspection and review of instrumentation data and surveillance reports;
- Evaluation of project performance with respect to PFMs; and
- A review and evaluation of other dam safety program elements.

An outline is provided for the Periodic Inspection Report (PIR) and the Periodic Inspection Pre-Inspection Preparation Report (PI-PIPR). Additional information regarding the scope of a PI is provided in Section 16-5.

16-2.4.2 Comprehensive Assessment

The CA is an in-depth review of a project, including (but not limited to) the following components:

- A review of relevant background material;
- A detailed review and evaluation of the STID, design basis, construction, and analyses of record, which may require supporting independent calculations;
- A field inspection and review of instrumentation data and surveillance reports;
- Evaluation of project performance with respect to PFMs;
- A review and evaluation of other dam safety program elements;
- A PFMA; and
- A Risk Analysis (RA).

An outline is provided for the Comprehensive Assessment Report (CAR) and the Comprehensive Assessment Pre-Inspection Preparation Report (CA-PIPR). Additional information regarding the scope of a CA is provided in Section 16-6.

Comprehensive Assessment Review Meeting

Following submittal of a CAR, this Guideline requires participation in a review meeting and presentation by the IC Team to the FERC and licensee staff, either in person or via teleconference/webinar. The purpose of this meeting is to go over the findings and recommendations contained in the CAR. Additional information is provided in Section 16-7.5.

16-2.5 **Roles and Responsibilities**

16-2.5.1 **Licensees**

The licensee has the primary responsibility for scheduling and coordinating with the FERC, the IC(s), and IC Team, including submitting the Part 12D Inspection Plan to the FERC in a timely manner. The licensee must arrange for all relevant personnel to be available for the field inspection, PFMA, risk analysis, and any other special inspections and meetings that may be required. In addition, the licensee must provide adequate meeting space for the PFMA and RA and ensure that all necessary information is available and accessible for all parties to review in advance.

While licensees contract with and retain the services of the IC Team for the work associated with a Part 12D inspection, the IC Team must have sufficient freedom such that they can complete an independent review and assessment. Licensees are not to influence the conclusions or recommendations of the IC(s) or IC Team, and the IC(s) must document any requests by the licensee to modify any conclusions or recommendations prior to finalization of the Part 12D Report.

16-2.5.2 **Independent Consultant(s)**

One or more designated Independent Consultant(s) are responsible for signing and sealing (stamping) the final PIR or CAR. They should take a lead role in the IC Team and should contribute extensive dam-related experience. When an IC Team includes more than one IC, it may be beneficial to designate one of them as a Lead IC for organizational and communication purposes, though this is not required.

16-2.5.3 **Facilitators**

When an independent facilitator is required for a PFMA and RA workshop, they will fulfill the duties of the role as described in Chapters 17 and 18, respectively. While facilitators are not necessarily considered members of the IC Team, their role is important to the successful execution of the PFMA and RA. Therefore, the FERC requires any facilitators to be identified in advance.

16-2.5.4 **FERC Dam Safety Personnel**

FERC dam safety personnel will provide guidance and clarification on the expectations of the Part 12D process beginning with the reminder letter to the licensee, continuing with the pre-inspection coordination calls, and during any PFMA and RA sessions. During the field inspection, FERC personnel will typically perform their routine dam safety inspection alongside the IC Team and licensee personnel.

Table 2: Typical Timeline, Periodic Inspection

Licensee Activity	Approximate Time	FERC Activity
	18 months before PIR due date	**FERC-RO Issues Part 12D Reminder Letter**
Participates in Initial Coordination Call	30 days after Reminder Letter is issued	*FERC-RO holds Initial Coordination Call with Licensee*
Licensee develops the scope of work, identifies the required disciplines for the IC Team, and identifies one or more people to serve as the IC(s)		
Submit Part 12D Inspection Plan to FERC-WO	6 months in advance of the first IC Team activity	
	Within approximately 30 days after submission of the Part 12D Inspection Plan	**FERC-WO responds to Part 12D Inspection Plan**
Participates in Second Coordination Call	Within 4-6 weeks of Approval (or Conditional Approval) of the Part 12D Inspection Plan	*FERC-RO holds Second Coordination Call with Licensee and IC Team*
IC Team performs their review of existing information, prepares the PI-PIPR, and provides it to the Licensee		
Submit PI-PIPR to FERC-RO	At least 30 days prior to the field inspection	
	Approximately 3 weeks after submittal of the PI-PIPR	**FERC-RO Responds to the PI-PIPR**
Site Inspection	Date(s) previously coordinated with all parties in advance	*Attends Site Inspection*
IC Team prepares the PIR and provides it to the Licensee		
Submit PIR to FERC-RO	Due Date as stated in the Part 12D Reminder Letter	
Submit Plan and Schedule to address IC Recommendations	Within 60 days after submitting the PIR	
FERC reviews the PIR		
		FERC-RO responds to the PIR

Bold text indicates an item that will be submitted to or issued by the FERC.
Italicized text indicates an in-person or teleconference activity.
Underlined text that spans across all three columns represents an activity, either by the Licensee, IC Team, or the FERC, that does not require formal communication or coordination.

Table 3: Typical Timeline, Comprehensive Assessment

Licensee Activity	Approximate Time	FERC Activity
	18 months before CAR due date	**FERC-RO Issues Part 12D Reminder Letter**
Participates in Initial Coordination Call	30 days after Reminder Letter is issued	*FERC-RO holds Initial Coordination Call with Licensee*
Licensee develops the scope of work, identifies the required disciplines for the IC Team, and identifies one or more people to serve as the IC(s)		
Submit Part 12D Inspection Plan to FERC-WO	6 months in advance of the first IC Team activity	
	Within approximately 30 days after submission of the Part 12D Inspection Plan	**FERC-WO responds to Part 12D Inspection Plan**
Participates in Second Coordination Call	Within 4-6 weeks of Approval (or Conditional Approval) of the Part 12D Inspection Plan	*FERC-RO holds Second Coordination Call with Licensee and IC Team*
IC Team performs their review of existing information, prepares the CA-PIPR, and provides it to the Licensee		
Submit CA-PIPR to FERC-RO	At least 30 days prior to the first IC Team activity	
	Approximately 2 weeks after submittal of the CA-PIPR	**FERC-RO Responds to the CA-PIPR**
Site Inspection	Date(s) previously coordinated with all parties in advance	*Attends Site Inspection*
PFMA		*Attends PFMA*
Level 2 Risk Analysis		*Attends Level 2 Risk Analysis*
IC Team prepares the CAR and provides it to the Licensee		
Submit CAR to FERC-RO	Due Date as stated in the Part 12D Reminder Letter	
Submit CAR Review Meeting Presentation to FERC-RO	At least 7 days prior to the CAR Review Meeting	
CAR Review Meeting	Within 60 days after submitting the CAR	*Attends CAR Review Meeting*
Submit Plan and Schedule to address IC Recommendations	Within 60 days after submitting the CAR	
FERC reviews the CAR		
		FERC-RO responds to the CAR

Bold text indicates an item that will be submitted to or issued by the FERC.
Italicized text indicates an in-person or teleconference activity.
Underlined text that spans across all three columns represents an activity, either by the Licensee, IC Team, or the FERC, that does not require formal communication or coordination.

16-3 INDEPENDENT CONSULTANTS, INDEPENDENT CONSULTANT TEAMS, AND PART 12D INSPECTION PLANS

16-3.1 Background

The regulations establish specific requirements of an Independent Consultant (IC), including professional licensure, a minimum of ten years of experience, and not being an employee or agent of the licensee or its affiliates. This section elaborates on those requirements, which are provided in 18 CFR § 12.31(a). This section also discusses the requirements of the Part 12D Inspection Plan, which includes the names and resumes of the IC(s); and the requirements of the IC Team, which is defined in 18 CFR § 12.41(b)

16-3.2 Independent Consultant Requirements

The basic requirements for an IC are set forth in 18 CFR § 12.31(a) and include three general requirements related to professional licensure, experience, and relationship status with the licensee. Each of these is described in more detail below.

1. Professional Licensure. 18 CFR § 12.31(a)(1) requires that the IC(s) who sign and seal the report be a licensed professional engineer(s). The IC(s) should be licensed in the state(s) in which the project is located.
2. Dam Design and Construction Experience. The minimum of ten years of experience in dam design and construction, and in the evaluation and assessment of the safety of existing dams, must be demonstrated in a detailed resume (discussed subsequently in this Guideline).
3. Relationship Status with Licensee. 18 CFR § 12.31(a)(3) through § 12.31(a)(5) place three limiting conditions on who may serve as an IC based on the current or previous working relationships between the proposed IC and the licensee or its affiliates. Two of these conditions are self-explanatory:

    - A current employee of the licensee or its affiliates cannot serve as IC; and
    - A person who was an employee of the licensee or its affiliates within the previous two years cannot serve as IC. This period is measured from the date of termination of employment to the date the proposed IC will begin performing any work as an IC on behalf of the licensee, including preparatory review for an inspection. If necessary, an IC Team proposal should clearly identify the dates of termination of prior employment and start of IC services.

    The third limiting condition, 18 CFR § 12.31(a)(5), requires review and evaluation by the FERC on a case-by-case basis to determine the extent of the relationship between the proposed IC and the licensee or its affiliates, and whether any restrictions are warranted. The following paragraphs provide some examples and how the FERC may consider them.

- Licensees with a contracted Chief Dam Safety Engineer (CDSE): some licensees choose to retain the services of a consultant or consulting firm to fill the role of CDSE instead of having a CDSE on staff. **In no case will a consultant or consulting firm serving as CDSE for a project be approved as an IC for the same project.**
- Licensees with a Chief Dam Safety Coordinator (CDSC): licensees who have a CDSC instead of a CDSE are required to retain the services of a consultant or a consulting firm to provide dam safety engineering services. **In no case will a consultant or consulting firm providing such services for a project be approved as an IC for the same project.**
- PI following a CA: after a CA, a number of significant studies or analyses may be needed to evaluate PFMs or recommendations of the IC Team. Licensees may be inclined to retain the IC or their consulting firm to perform those studies. If the licensee proposes the same IC or consulting firm for the subsequent PI, it may seem like the IC is "an agent acting on behalf of the licensee or its affiliates." However, the scope of a PI does not include an in-depth review and evaluation of the analyses of record or other studies. Thus, this would most likely not represent a conflict of interest. There may even be benefits to the PI being performed by the same IC that did the previous CA, as they would already be very familiar with the project documentation.
- Engineers-of-Record: consider a situation in which Person A was the engineer-of-record for, or contributed significantly to, stress and stability analyses completed within the previous several years. If a licensee proposes Person A to serve as the IC responsible for evaluating the stability analyses as part of a CA, Person A will most likely be rejected.

The intent of 18 CFR § 12.31(a)(5) is to prevent a member of an IC Team from reviewing their own work, or the work of others employed by the same consulting firm. If an IC team has multiple ICs, the licensee's proposal must clearly define the scope of each IC's responsibility, which should alleviate some of these concerns.

Other IC constraints include:

- The first report (CA) for newly constructed projects, or projects where a major dam safety remediation has recently been completed, may be done by the design engineer or an engineer from the design engineer's firm. The next report (either PI or CA) must be completed by a different engineer not associated with either the design or construction firm. Subsequent reports may be completed by an engineer associated with the design, construction, or remediation work.

- An engineer, or engineers from the same firm, will not be approved as an IC for more than two consecutive reports (PI or CA) for any project, or for consecutive CAs for any project.

16-3.3 Part 12D Inspection Plans

18 CFR § 12.34(a) requires the licensee to obtain the written approval of the IC Team from the Director of D2SI prior to performance of a Part 12D Inspection. The Part 12D Inspection Plan is the submittal required to convey information related to the qualifications of the IC Team.

16-3.3.1 Content of the Part 12D Inspection Plan

The Part 12D Inspection Plan must include the following information:

- Project name, FERC number, and state(s) where the project is located;
- Type of Part 12D Inspection (CA or PI), and whether a RA is included for a CA;
- A brief description of the project features;
- An IC Team Proposal, including the identification and assessment of technical disciplines to be represented on the IC Team; the names and resumes for the IC(s); a list of supporting team member roles and their intended areas of expertise; and the names and resumes of facilitators for any PFMA or RA as needed; and
- A schedule for Part 12D Inspection-related activities.

If there are any potential conflicts of interest – for example, a member of the IC Team performed a substantial fraction of the work on a critical study – those should be described in the Part 12D Inspection Plan, along with how the IC Team will be structured to avoid a conflict of interest.

Additional information regarding the Part 12D Inspection Plan is provided below; an example outline is provided as Appendix 16-A.

16-3.3.2 IC Team Proposals

Selection of the Independent Consultant(s) is critical to the success of the project. The IC(s) must possess the appropriate dam design and construction experience; understand the requirements of an IC described in this Chapter of the Engineering Guidelines; be able to lead the IC Team; and be able to communicate the findings and recommendations of the reviews, assessments, and inspection.

Collectively, the IC Team must have “demonstrable experience and expertise with dam design, construction, and in the evaluation and assessment of the safety of existing dams, commensurate with the scale, complexity, and relevant technical disciplines of the project

and type of review, inspection, and assessment being performed…" [18 CFR § 12.31(b)]. In order to fulfill this requirement, the IC Team Proposal must:

1. Identify the Required Technical Disciplines for IC(s) and supporting team members;
2. Identify the Independent Consultant(s); and
3. Demonstrate that the IC Team has the required experience.

As the scope of a CA is greater than the scope of a PI, the "demonstrable experience and expertise" threshold will likely be greater for a CA. Members of the IC Team for a CA will likely have to demonstrate greater technical proficiency related to the design and/or analysis of the types of project features under consideration. In addition, for the same project, the IC Team for a CA may require more members than for a PI. Conversely, there may be some technically simple projects, with sufficiently low risk, that a single IC may be able to perform a PI or even a CA without any supporting team members.

16-3.3.2.1 Identification of the Required Technical Disciplines

In order to determine the composition of the IC Team, an assessment of the project features and project setting must be performed. This assessment must include:

- A summary of project features, including all water-retaining and water-conveying structures at the project and major components critical to project operation;
- An understanding of the project setting, such as site geology, the magnitude and frequency of seismic loading, magnitude and frequency of hydrologic loading, upstream and downstream consequences, etc.; and
- Any past or ongoing studies or dam safety incidents requiring specialized experience.

This assessment must be included in the proposal and used to identify the technical disciplines and levels of experience required of the IC Team to properly review, inspect, evaluate, and assess the project features and associated studies.

For example, if a project does not include a type of feature, certain technical disciplines may not be needed on the IC team (e.g., if a project has an uncontrolled overflow spillway and no gates, there may not be a need for a mechanical or electrical engineer). Similarly, a project located in a low seismic setting (e.g., northern Minnesota) will likely not require an expert seismologist. A sample format for providing this information is provided in Table 6, which is located at the end of this section. **The information in that table is provided only for demonstration purposes.**

The FERC has not established criteria for the degree of expertise or technical proficiency (e.g., novice, intermediate, advanced, expert, etc.) required for any particular type of

feature or situation. Each project is unique and the needed level of proficiency may be influenced by the dam height, dam age or era of design, history of satisfactory or unsatisfactory performance, general uncertainty with conditions or design assumptions, or many other factors.

As general guidance, Table 7 (located at the end of this section) presents some of the technical disciplines that may be relevant to various project features, along with examples of those elements that each discipline may be required to review and/or factors that affect the overall complexity of the discipline's review. The FERC will consider the relevant review elements when evaluating the degree of technical proficiency required for a given project. **The information in Table 7 is not comprehensive and other factors will be considered on a case-by-case basis. Do not use the information provided in Table 7 as criteria – it is general guidance.**

Mechanical and electrical engineers, with formal training and years of specialized experience, can provide valuable insight into the function and expected performance of many project features. General civil engineers can gain a working knowledge of the mechanical and electrical systems; licensee operations staff can provide important, and often insightful, background information about how the project operates; however, the IC Team should consider including one or more members to represent the mechanical and electrical disciplines. The following are some situations in which mechanical and/or electrical engineers should be included:

- Projects with a large number of gates or a variety of gate types;
- Projects with limited redundancy (e.g., a single spillway with one gate at an embankment dam);
- Projects that have power generation facilities which are required to remain operable to safely pass flood flows; or
- Projects with a history of mechanical and/or electrical problems.

16-3.3.2.2 **Identification of IC Team Members**

The licensee must identify the role, technical discipline(s), and demonstrate the technical proficiency for each member of the IC Team. The table below provides a suggested format for providing this information to the FERC. **Note that the names of supporting team members do not have to be provided in the Part 12D Inspection Plan**; refer to Section 16-4.3 for details on how to provide that information as part of the corresponding PIPR.

Table 4: IC Team Composition for Part 12D Inspection Plan (EXAMPLE)

Name	Role	Technical Discipline(s)
Mr. Douglas Clay	Independent Consultant	Geotechnical
Ms. Samantha Waters	Independent Consultant	Hydraulics and Hydrology
TBD	Team Member	Structural
TBD	Team Member	Mechanical/Electrical
TBD	Team Member	Geology
TBD	Team Member	Seismicity

For a CA, the name(s), qualifications, and resumes of the PFMA facilitator(s) and RA facilitator(s) shall also be provided. Qualifications for PFMA and RA facilitators are discussed in Chapters 17 and 18 of the Guidelines, respectively.

Table 5**Error! Reference source not found.** summarizes the roles and responsibilities of key Part 12D Inspection positions. **The licensee must carefully consider the responsibilities of the IC(s) relative to their potential role in the PFMA and RA for a CA.** An IC could potentially serve as a core team member (subject matter expert), facilitator (if qualified), or reviewer of the PFMA and RA. Selecting the appropriate role for the IC for the PFMA and RA depends on a number of factors, including:

- Availability of other qualified PFMA and RA facilitators.
- The qualification and experience of the IC to serve as a facilitator.
- Using the IC as a participant to leverage their knowledge of the project gained through the review of the project records.
- Adding the responsibility of facilitating the PFMA and RA on top of the already large workload and responsibility of the Part 12D review and inspection.

These factors and others should be considered in selecting the role of the IC and the facilitator(s) of the PFMA and RA. Note that a licensee is not permitted to serve as facilitator for either a PFMA or RA for their own project, and that if the IC does not serve as facilitator, then the facilitator should not be employed by the same company or organization as the IC. Additional details regarding the roles, responsibilities, and qualifications of the IC and facilitators with respect to the performance of a PFMA and RA are described in Chapters 17 and 18 of the Guidelines, respectively.

Table 5: Roles and Responsibilities of Key Part 12D Positions

Role	Qualifications	Responsibility		
		Part 12D	PFMA	Risk Analysis
Independent Consultant	Chapter 16, Section 16-3.2	Reviews project documents Performs site inspection Prepares Part 12D Report	Participant or Facilitator or Reviewer	Participant or Facilitator or Reviewer
PFMA Facilitator	Chapter 17, Section 17-4.3.3	-	Facilitator	Participant or Facilitator
Risk Facilitator	Chapter 18, Section 18-5.3	-	Participant or Facilitator	Facilitator

Supporting Members of the Independent Consultant Team

Other members of the IC Team, while they are not responsible for signing and sealing the report, and are not required to have at least ten years of experience, provide valuable technical expertise that ensures the IC Team is qualified to review, inspect, and assess a given project. Members of the IC Team are expected to inspect those physical features and review the portions of prior reports, as-built drawings, instrumentation data, etc. that are within the purview of their technical expertise. For example, an IC with a primarily geotechnical background would likely have to rely on a structural engineer to review and evaluate information related to a concrete arch dam.

16-3.3.2.3 **Resumes**

The resumes provided with an IC Team Proposal (or included with the PIPR) must clearly state the individual's role in each project listed (e.g., a member of a design team, QC/QA review, engineer of record, etc., along with the duration and scope of that role). A general list of projects, without context, is not acceptable and may result in rejection of the Part 12D Inspection Plan. The FERC will evaluate the resume and compare it to the stated technical discipline and proficiency; the resume must clearly document that the individual possesses the relevant knowledge and skills at the proficiency level identified in the submittal. Consider the following examples:

- Project A includes a 450-foot-high, double-curvature thin arch dam with thrust blocks on either side and an uncontrolled overflow spillway in the center of the crest. The dam is located in a high seismic area. The structural analyses of record include three-dimensional dynamic finite element models evaluating the potential

for rock block displacement, continuity of the arch (opening/closing of monolith joints) during the earthquake, and post-earthquake stability of thrust blocks on either side.

The IC Team should include a structural engineer who can demonstrate experience and understanding of tall, double-curvature thin arch dams; finite element modeling and its limitations; gravity structure analysis; and seismic loading on concrete structures; as well as an engineering geologist who can evaluate the performance and three-dimensional stability of the abutments and foundation subject to the same loading.

- Project B includes a 250-foot-high zoned embankment dam; a gated, concrete-lined service spillway with two 16-foot-high by 20-foot-wide radial gates; a 200-foot-wide uncontrolled emergency spillway with an earth and rock-lined chute; and a low-level outlet works. The project is located in an area of relatively low seismicity. Hydrologic analyses indicate the dam is overtopped at about 90-percent of the PMF. Downstream consequences are moderate.

  The IC Team should include a geotechnical engineer who can demonstrate knowledge and experience in internal erosion and overtopping erosion of tall embankment dams; a hydraulic structures engineer who can demonstrate experience and understanding of concrete-lined and earthen-lined spillways and low-level outlets; structural and electrical/mechanical engineers who can demonstrate knowledge and understanding in the design, construction, and operation of radial gates and low level outlets; and an engineering geologist/geotechnical engineer who can demonstrate knowledge and understanding of the erodibility (scour) of earth and rock-lined chutes and channels. In addition, the team would likely need to include a hydrologist/hydraulic engineer who can demonstrate knowledge and experience in flood routings and scour analyses.

Note that in each of the above examples, the required personnel are discussed only with respect to the specific project features listed. **Under no circumstances should these brief examples be used as justification NOT to include any particular discipline as part of an IC Team.**

16-3.3.3 **Proposed Part 12D Schedule**

The Part 12D Inspection Plan must include a proposed schedule for major activities and milestones. At a minimum, the following items must be listed with anticipated dates, informed by the timing presented in Table 2 or Table 3, as applicable:

- Submittal of the Pre-Inspection Preparation Report;
- Field/Site Inspection;

- PFMA and RA session(s), as applicable;
- Submittal of the PIR/CAR; and
- CAR Review Meeting, if applicable (CA only).

16-3.3.4 **Time to Submit the Part 12D Inspection Plan**

Licensees must submit the proposed IC Team and resumes far enough in advance that, in the event one or more members are rejected or supplemental information is requested, the schedule to complete the inspection or assessment is not affected. The Commission's regulations require that the resumes be submitted "at least 180 days prior to the performance of the Periodic Inspection or Comprehensive Assessment." This refers to the date of the first in-person activity (e.g., field inspection, PFMA, etc.), not the date the report is due. The FERC **strongly recommends** that the licensee submit the Part 12D Inspection Plan at least one year in advance of the due date of the report, even if that is greater than 180 days in advance of the first IC Team activity.

16-3.3.5 **FERC Review and Approval of Part 12D Inspection Plans**

The licensee is required to submit the Part 12D Inspection Plan to the Director of D2SI. Upon receipt, the FERC will review the information and provide a written response that may fall into one of the following general categories:

- **Approval** of the Part 12D Inspection Plan and entire IC Team;
- **Conditional Approval** of a portion of the Part 12D Inspection Plan or IC Team, with a request for minor revisions to the Part 12D Inspection Plan and/or supplemental information to describe the necessary expertise, demonstrate the experience of one or more members of the IC Team, and/or a request for additional members to provide a certain level of experience in one or more technical disciplines; or
- **Rejection** of the Part 12D Inspection Plan and/or IC team with a requirement to resubmit a new proposal.

Neither an IC nor an IC Team member is guaranteed approval for a particular Part 12D inspection simply because they have previously been approved in that role for a similar project in the past. The FERC may reject any proposed IC or IC Team member due to the specific IC Team Proposal under consideration not demonstrating that the person has sufficient relevant experience. In addition, the FERC may reject any person who has shown a consistent pattern of poor performance with respect to Part 12D inspections and the reports thereon, such that entrusting the performance of all or a portion of a Part 12D inspection to that individual presents a clear risk that potential dam safety deficiencies may be overlooked or inadequately considered.

16-3.3.5.1 **Changes to the IC Team After Approval**

As discussed previously, the Part 12D Inspection Plan is required to be submitted at least 180 days in advance of the first IC Team activity, and is requested to be submitted at least one year in advance of the due date of the report. There may be situations in which key members of the IC Team are no longer available to participate after receiving FERC approval but before performance of the inspection or completion of the Part 12D report. If an IC or facilitator is no longer able to participate, a revised Part 12D Inspection Plan must be submitted to D2SI-WO as soon as practicable. Critical activities such as the inspection, PFMA, and RA may not proceed without an approved IC Team.

The names and resumes of supporting members of the IC Team are not required to be included in the Part 12D Inspection Plan; they are to be provided in the cover letter transmitting the PIPR (which is discussed in the subsequent section of this Guideline). As such, the FERC does not anticipate many situations in which supporting team members are changed on short notice. However, in the event that a key supporting team member is unable to attend, portions of the inspection, PFMA, or RA may need to be redone in their presence.

Table 6: Technical Expertise Considerations (EXAMPLE)

BIG DAM PROJECT, FERC No. 98765 IC Team Technical Disciplines and Issues		
Project Feature	**Relevant Technical Disciplines**	**Identified Issues and/or Technical Complexity**
Embankment Dam	Geotechnical	Hydraulically or semi-hydraulically placed fill Unfiltered seepage exit on downstream slope/toe Inadequately designed embankment filters High phreatic surface in embankment Steep slopes
Embankment Dam Foundation and Abutments	Geology	Overhangs at fill/structure contact Lack of batter at fill/structure contact Evidence of differential settlement at structure interfaces Karst foundation Liquefiable foundation Incompatible filter for foundation blanket Evidence of seepage through abutments
Concrete Arch Dam	Structural	Double-curvature thin arch dam with instrumentation data that suggests there may be adverse performance.
Arch Dam Foundation and Abutments	Geology	River deposits remain in channel to a depth 100 feet below the base of the dam. Abutments contain complex joint sets and potentially releasable blocks critical to dam stability. History of small rock slides. Significant differences in rock mass influences foundation rock modulus.

BIG DAM PROJECT, FERC No. 98765 IC Team Technical Disciplines and Issues		
Project Feature	**Relevant Technical Disciplines**	**Identified Issues and/or Technical Complexity**
Radial Spillway Gates	Structural	Gates are of modern design with no problematic detailing.
	Mechanical/Electrical	Project has twelve radial gates with multiple backup power sources, antiquated hoist equipment, and complex SCADA systems. History of failure to operate due to mechanical issues. Lack of personnel to operate gates in a timely manner in an emergency situation
	Hydraulics	Gate configuration and inlet conditions are simple.
Overall Project Hydrology and Hydraulics	Hydrology and Hydraulics	Project is located in a small basin; hydrology is well-understood and is current. No concerns related to flood passage if project is fully operational.
Downstream Hazard Potential	Emergency Response	High consequences – City of Damsville, population 30,000 is located 2 miles downstream. Limited or negative excess response time in many locations.
Overall Project Seismicity	Seismicity	Project is located in an extremely low seismicity area. Structures are very unlikely to sustain damage from an earthquake.
Overall Project Instrumentation	Instrumentation and/or Programming	Project is heavily instrumented; numerous types of instruments on multiple types of dam sections. Instrumentation is connected to an ADAS with programmed alarms that consider statistical correlation and seasonal behavior.

Table 7: Selected Technical Disciplines and Review Elements by Type of Project Feature (EXAMPLES)

Project Feature and/or Consideration	Technical Discipline	Review Elements and Factors to Consider
Concrete Gravity Dams and their Foundations	Structural	Anchors AAR Height Tailwater washout Drains required for stability Stability at lift joints
	Geology	Weak planes below foundation contact Erodible foundation material at toe or along abutments that overtop during floods Karst in foundation Competency of foundation bedrock (asperities, favorable bedding angle, soundness of rock, etc)
Arch Dams and their Foundations	Structural	Height, thickness, and type of arch dam. History of concerning instrumentation data.
	Geology	Abutments contain complex joint sets and potentially releasable blocks critical to dam stability. Significant differences in rock mass influences foundation rock modulus.

Project Feature and/or Consideration	Technical Discipline	Review Elements and Factors to Consider
Embankment Dams and their Foundations	Geotechnical	Height of dam Slopes Unfiltered exits Filter installed but not designed to current standards Instrumentation documentation of elevated phreatic surface Hydraulic or semi-hydraulic fill Type of cutoff Embankment materials
	Geology	Karst foundation Liquefiable foundation Erodible foundation or abutment materials High foundation water pressures Soft, weak layers in foundation
Canal Embankments and their Foundations	Geotechnical	Lack of modern design and construction Unfiltered seepage Inadequate freeboard Inadequate control of inflow into canal Inadequate spillway capacity to control flood flows Steep slopes Excess vegetation on slopes Unfiltered penetrations through embankment (old pipelines, old structures, etc.) Length of canal embankment
	Geology	Liquefiable foundation or embankment materials Karst foundation Erodible foundation materials High foundation water pressures Soft, weak layers in foundation

Project Feature and/or Consideration	Technical Discipline	Review Elements and Factors to Consider
Lined Spillway Chutes	Structural	Era of construction (i.e., typical detailing of joints and slab, drainage, anchoring, etc.). Flow velocities and potential for cavitation and/or stagnation pressure. Criticality of spillway operability to pass flows.
	Hydraulics	Flow velocities and depths Drainage, reinforcing, anchor, and joint details Susceptibility to stagnation pressure/slab-jacking Erodibility of material potentially exposed to spillway flow in the event of chute failure Available analyses of spillway stability
Unlined Spillway Chutes	Hydraulics Geology/Geotechnical	Flow velocities and depths Erodibility of material potentially exposed to spillway flow Available analyses of spillway stability
Penstocks	Structural	Era of construction (riveted, bolted, welded, material specifications) Condition of penstock (e.g., Total head Geometry (e.g., horizontal and/or vertical curves with critical thrust blocks and/or saddles)
	Hydraulics	History of or susceptibility to cavitation damage
	Mechanical	History of load rejections/water hammers due to valve issues Criticality of penstock availability for passing required flows

Project Feature and/or Consideration	Technical Discipline	Review Elements and Factors to Consider
Spillway Gates	Structural	Structural capacity of gates with respect to anticipated loading conditions. Number of types of gates and their relative structural complexity. Redundancy in number of gates and overall complexity of mechanical/electrical systems. Sensitivity of flood routing with respect to gate availability and operations. Binding due to AAR
	Mechanical	Age of hoist Moveable or fixed hoist Multiple moveable hoists Redundancy in backup methods of mechanical operation (e.g., crane lift, electric drill, etc.) Operational history
	Electrical	Redundancy of power supply Locations of backup power sources and routes of power supply Remote operation Hoist motor capacity with respect to demand Operational history
Overall Project Hydrology and Hydraulics	Hydrology and/or Hydraulics	Ability of the project to pass the PMF/IDF Complexity of PMP/PMF study (e.g., site-specific, new methodologies, etc.)
Overall Project Seismicity	Seismology	Magnitude of seismic loading. Uncertainty regarding seismic sources, methodologies, or ground motions Susceptibility of project structures to seismic loading

Project Feature and/or Consideration	Technical Discipline	Review Elements and Factors to Consider
Overall Project Instrumentation	Instrumentation and/or Programming	Variety of instrument types installed Variety of project features instrumented Level of automation in data acquisition, processing, and alarms Criticality of instrumented monitoring to ensuring project safety

16-4 PRE-INSPECTION PREPARATION REPORTS

16-4.1 Purpose

In the PIPR, which is required by 18 CFR § 12.40 for both a PI and a CA, the IC Team is expected to document the findings of their review of existing information. This provides a structure to record the IC Team's preliminary evaluation of dam and public safety programs, analyses of record, instrumentation data, etc., which can help ensure that the IC Team is adequately prepared to perform the site inspection and PFMA/RA, as applicable.

Any information included in the PIPR will be considered preliminary. The FERC does not expect the PIPR to include any final findings or conclusions. It is entirely acceptable, and even expected, for the IC Team to acquire new information or a different understanding of the project and its components between completion of the PIPR and the final Part 12D Report.

The FERC does not intend to compare the PIPR to the final Part 12D Report. The FERC will review and evaluate the PIPR to determine whether the IC Team is adequately prepared, and will issue a formal response. **If it is apparent from the review of the PIPR that the IC Team has not adequately prepared, the FERC reserves the option to require postponement of the first IC Team activity**. Any such postponement will not affect the due date for the Part 12D Report.

16-4.2 Required Documentation in the PIPR

Table 8 lists the information required for the PIPR; outlines for the PI-PIPR and CA-PIPR are provided in Appendix 16-C and Appendix 16-E, respectively.

Table 8: Pre-Inspection Preparation Report Requirements

Documentation	Required for CA-PIPR?	Required for PI-PIPR?
Potential deficiencies in the previous description and/or understanding of project works.	Yes	Yes
Potential design or construction-related issues.	Yes	No
Potential deficiencies (accuracy, relevance, current state-of-the-practice) in the analyses of record.	Yes	No
Project status, including a list of recent modifications to project works, operations, and the status of previous Part 12D recommendations.	Yes	Yes
Review and interpretation of instrumentation data.	Yes	Yes

Documentation	Required for CA-PIPR?	Required for PI-PIPR?
Draft revised PFMs developed by the IC Team during their review of the information.	Optional	No

16-4.3 Additional Information Required from the Licensee

As noted in Section 16-3.3, the Part 12D Inspection Plan is not required to contain the names or resumes of supporting team members. **The letter transmitting the PIPR must contain the final composition of the IC Team**; Table 9 provides an example of how to format this information. The letter should indicate which activities each member will participate in (e.g., field inspection, PFMA, RA, report preparation, etc.). Resumes demonstrating the experience of the supporting team members must be attached to the letter.

Table 9: IC Team Composition for PIPR Transmittal Letter (EXAMPLE)

Name	Role	Technical Discipline(s)
Mr. Douglas Clay	Independent Consultant	Geotechnical
Ms. Samantha Waters	Independent Consultant	Hydrology and Hydraulics
Ms. Carol Gates	Team Member	Structural
Mr. Max Power	Team Member	Mechanical/Electrical
Ms. Linda Stone	Team Member	Geology
Mr. Steve Shaker	Team Member	Seismicity

16-5 PERIODIC INSPECTIONS

16-5.1 General

The scope of a Periodic Inspection is established in 18 CFR § 12.35 and comprises the following:

- A thorough review of existing information to familiarize the IC Team with the relevant background and historical information to allow proper evaluation of project features;
- Review and evaluation of dam and public safety programs (e.g., Operations and Maintenance Program, Public Safety Plan, Owner's Dam Safety Program, etc.);
- Review and evaluation of instrumentation data and surveillance reports;
- A physical field inspection; and
- Preparation of the Periodic Inspection Report.

The Federal Guidelines for Dam Safety [reference] recommend that an independent evaluation occur at least once every five years. A PI, which typically occurs five years after a CA, fulfills this recommendation.

This section provides more detail on the scope of each component of the PI along with discussion of the documentation requirements. It describes the minimum expected level of effort for preparation and performance of the PI and completion of the PIR. An outline of the PIR, which is included in Appendix 16-B, can be used as a template and rough guide for the contents of each section.

16-5.2 Review of Prior Reports

The IC Team is required "to have, at the time of the inspection under [18 CFR Part 12, subpart D], a full understanding of the design, construction, performance, condition, downstream hazard, monitoring, operation, and potential failure modes of the project works." The IC Team shall perform all necessary review, prior to the field inspection, to meet this requirement, which is established in 18 CFR § 12.35(a). At a minimum, this should include review of the two preceding Part 12D Inspection Reports, the most recent PFMA report, and other relevant information in the STID.

A PI is not required to include a formal PFMA workshop. However, at the time of the field inspection, IC Team members should have a full understanding of the loading conditions, failure mechanisms, and conditions identifiable during a field inspection that may indicate any PFM is active or developing.

Based on the contents of the PI-PIPR, and how knowledgeable IC Team members are at the time of the field inspection, it will be apparent whether sufficient review was performed. **If the IC Team is not adequately prepared, the FERC may require the**

field inspection to be performed again, at a later date, following further review of project records by the IC Team.

16-5.3 Observations and Evaluations of Performance

This section of the PIR has been structured to help ensure that findings are thoroughly documented and evaluated for each project feature. Four headings, listed below, are required for each project feature.

Field Inspection Observations

Review and Evaluation of Instrumentation Data and Surveillance Reports

Evaluation with Respect to Potential Failure Modes

Conclusion

The evaluation of PFMs for each feature must consider both the field inspection findings and an independent interpretation of instrumentation data and surveillance reports. **It is not acceptable to rely entirely on previous interpretations, nor is it acceptable to state that instrumentation data does not indicate a potential issue simply because it is not changing over time.**

The PIR must include a discussion of the field observations relative to each of the identified potential failure modes as well as the Independent Consultant's own assessment of the significance of the identified potential failure modes; whether any other (previously unidentified) potential failure modes may exist; and conditions that have changed and may impact previous conclusions regarding potential failure modes. The PIR must provide sufficient documentation to support whatever the stated conclusion is with respect to each identified PFM and the overall suitability of the feature for continued operation.

The overall conclusion for each project feature should be clear and based on the discussion that precedes it. It is not necessary to reiterate information as long as the rationale is apparent from the preceding discussion. The requirements of physical field inspection and review of instrumentation data and surveillance reports are discussed below.

16-5.3.1 Physical Field Inspection

The requirement for a physical field inspection is established in 18 CFR § 12.35(b). The physical field inspection must include a detailed visual observation of all physically accessible project features by one or more members of the IC Team. Each portion of the inspection should be observed by at least one Independent Consultant, plus any members of the IC Team qualified to evaluate that type of project feature (e.g., a structural engineer should not be the primary inspector for an embankment dam). The Bureau of

Reclamation Safety Evaluation of Existing Dams (SEED) Manual may be used as a reference for general procedures related to the inspection of dams and project works.

If there are any credible PFMs related to the reservoir rim, visual inspection of the relevant portion is required. Otherwise, it may be sufficient to visually observe the reservoir rim within the immediate vicinity of the project works.

Spillway chutes, whether lined or unlined, should be inspected up close to the extent possible. The FERC recognizes that some spillways are too steep to be inspected without extensive preparation, and that in some cases a licensee or IC Team may choose to have only a specially-trained (e.g., rope access) team perform the inspection for safety considerations. In that case, it may be acceptable for the IC Team to review a detailed inspection report (e.g., a focused spillway assessment report) prepared by another qualified party within the previous year. It is preferred that one or more members of the IC Team at least observe the special inspection. The Regional Engineer may provide additional requirements related to the spillway chute inspection in the inspection reminder letter.

If possible, the relevant members of the IC Team should observe full-height spillway gate test operations. In many cases, this may require significant coordination (e.g., placement of dewatering bulkheads, a low reservoir, preexisting high flows to limit downstream effects, etc.). If circumstances do not permit the observation of full-height gate tests, the IC Team still must observe test operations of a representative number of gates such that they can evaluate the gate performance, licensee's standard operating procedures, and provide informed conclusions.

Every power source available for operation of gates must be tested and used to operate a gate during the inspection. If there are multiple backup power sources – for example, a diesel-powered generator, a portable propane-powered generator, and a battery bank – each should be used. If the licensee's standard operating procedures include other emergency methods for operating a gate – such as a using a lifting beam and portable crane, or attaching a hand crank – the IC Team should confirm that the required equipment is available and that licensee staff are sufficiently familiar with the procedures.

The IC Team shall review all reports on special inspections that have occurred since the previous Comprehensive Assessment or within the preceding five years, whichever period is longer. Some examples of special inspection reports are:

- Underwater inspections;
- Hands-on gate inspections;
- Focused spillway assessments;

- Special access inspections (confined space, rope access, etc.), including of penstocks and tunnels;
- Camera scope inspections of drains, conduits, and other features;
- Aerial drone inspections; and
- Other inspections as applicable.

16-5.3.2 **Review of Instrumentation Data and Surveillance Reports**

The requirement to review surveillance and monitoring data is established in 18 CFR § 12.35(c). **This is a critical component of the Periodic Inspection and is equally important as the field inspection**. Previous dam safety incidents may have been avoided, or the urgency of response and remediation reduced, had the instrumentation data been reviewed with more careful consideration.

The review of monitoring data must be a critical, thorough review of the data itself. It is not acceptable for the IC Team to review only the instrumentation data plots prepared by the licensee and included in the annual DSSMR submittal. The licensee must provide the IC Team with all available data such that the IC Team can identify, describe, and evaluate:

- Relationships between instrument readings and environmental factors such as reservoir elevation, precipitation, air/water temperature, project operations, etc.;
- What constitutes expected behavior for each instrument (and, by extension, what constitutes unexpected behavior);
- Whether there are any historic readings or ongoing trends that may indicate adverse behavior; and
- Whether any established thresholds, automated alarms, etc. are set such that they will trigger appropriate follow-up actions prior to substantial progression of a potential failure mode.

The IC Team must review surveillance reports to supplement their field inspection observations. The findings of previous inspections should be compared to the current findings, with discrepancies and changes in performance noted.

In order to properly complete this aspect of the PI, the IC Team must understand the purpose, function, and expected behavior of each instrument or feature. It is not sufficient to simply identify trends or threshold exceedances, or the lack thereof. It is not acceptable to rely entirely on a previous interpretation or to state that data is acceptable simply because the behavior is consistent over time. The IC Team must thoughtfully consider each instrument and surveillance report; describe the expected behavior of each; and identify any observations or data that is unexpected or indicative of adverse performance. Statistical analysis may be required for complex, heavily-instrumented projects or large

data sets. **It is not acceptable to state that previous evaluations did not identify any problems, that no changes in behavior were identified, and thus the data is acceptable.** The documented rationale may refer to previous evaluations but must not rely on them.

The IC Team should consider collecting manual readings of critical monitoring instruments (e.g., piezometers, crack gages, plumblines, etc.) during the field inspection. This provides valuable information about the condition of the project at the time of the inspection. It also gives the IC Team an opportunity to review the licensee's manual data collection procedures. Any readings collected should be noted and evaluated in this section.

16-5.4 Review and Evaluation of Dam and Public Safety Programs

The requirement for review of dam and public safety programs is established in 18 CFR § 12.35(d); the review of surveillance and monitoring is required by 18 CFR § 12.35(c). In each section, the PIR must include a clear statement that the IC Team reviewed the information, along with any findings and recommendations. Some additional considerations are discussed below.

This aspect of the review is documented in Sections 5.1 through 5.6 of the PIR.

16-5.4.1 Owner's Dam Safety Program

Although the licensee may opt to have the IC Team review the ODSP, the IC Team is not required by the FERC to perform a detailed review of the written ODSP document or conduct extensive, focused interviews with project staff. The FERC requires only that the IC Team be sufficiently familiar with the written ODSP and the FERC guidance thereon that they are able to evaluate whether it is being implemented appropriately with respect to the project being inspected.

During preparation and performance of the Periodic Inspection, the IC Team should take note of any actions, requests, responses to unusual events, or other situations that may indicate licensee staff do not strictly adhere to the tenets espoused in the written ODSP. These should be noted in the PIR; if there are no such situations, that should be stated.

16-5.4.2 Performance Monitoring Program (Surveillance and Monitoring)

The IC Team must be familiar with the written protocols for surveillance of the project works, including any inspection checklists the licensee maintains, which are typically documented in a Dam Safety Surveillance and Monitoring Plan. It is important to understand the layout of existing instrumentation as well as the installation details, function, performance, and reading frequency/procedures (both manual and automated). The depth of review must be sufficient so the IC Team:

- Understands the function and purpose of each instrument and surveillance procedure;
- Knows what observations or recorded data may indicate the onset or progression of a PFM, or conditions that are otherwise out-of-the-ordinary with respect to general health; and
- Can make informed recommendations for improvements (e.g., new instrumentation, changes to procedures, etc.).

The evaluation must consider both the surveillance procedures and instrumentation and their effectiveness at monitoring for the identified PFMs as well as general health. For each PFM, the IC Team must review whether the monitoring program is adequate to detect the onset of the PFM, or conditions that may contribute to or "allow" development of the PFM, in a timely manner. The ICs should provide comments that relate historic and current performance indicators (i.e., monitoring data) to identified PFMs. The ICs should also address whether the instrumentation at the dam is functioning properly and is adequately maintained.

The ICs should specifically consider whether inspections during and after unusual conditions (e.g., high pool elevations not previously experienced, high flow events, seismic events, etc.) or related to inaccessible features are of an appropriate scope and performed at an appropriate frequency.

The IC Team must also review procedures for and the timing of licensee engineering review (e.g., data reduction and analysis) of instrumentation data and surveillance reports, and any reporting of adverse or unusual findings to more senior personnel for investigation or other action.

16-5.4.3 **Hazard Potential Classification**

Hazard potential classifications are defined in 18 CFR § 12.3 and Chapter 1 of the Engineering Guidelines. The IC Team is required to review the conditions upstream and downstream of a project to evaluate:

- Whether the current hazard potential classification is appropriate, and
- Whether any changed conditions warrant reconsideration of the sudden failure assessment (SFA) or other procedures in the Emergency Action Plan.

The IC Team shall review the conditions upstream and downstream of project structures and take note of any changes to development (e.g., a significant increase in the population at risk, new developments below structures classified as low or significant hazard, or new structures closer to the project than those previously identified). When evaluating whether the hazard potential classification remains appropriate, the IC Team should also consider the effects that failure may have on environmental and cultural

resources; critical infrastructure, such as major highways and municipal water supplies; and other conditions as applicable.

A visual review is preferred but in some cases, conversations with the licensee and a review of aerial or satellite imagery can suffice. It is important to note the date of publicly available imagery, as it can be out-of-date in remote areas. Conversations with licensee staff regarding changes to downstream development should be documented. The findings must be documented in the PIR and appropriate recommendations provided.

16-5.4.4 **Emergency Action Plan**

Typically, no members of the IC Team will be required to have specialized experience in emergency response procedures. However, an EAP is such an important component of a dam safety program that the IC Team must have sufficient general knowledge to review and comment on it. There may be cases in which emergency response personnel would be appropriate to include as part of the IC Team.

If the project is subject to 18 CFR Part 12, Subpart C, the IC Team must review the EAP, including the inundation maps (the review of dam breach analysis is not a component of a PI). The review shall consider the written EAP document as well as the licensee's training procedures, coordination with outside persons and agencies, and the familiarity of project staff with their roles and responsibilities.

If any EAP activations or functional/full-scale exercises have occurred since the previous Part 12D Report, the IC Team must review and evaluate the after-action report and licensee's plan of action.

If a Sudden Failure Assessment (SFA) has been performed for the project, the IC Team must review the assumptions, procedures, and evaluate the findings. Any project with an excess response time (ERT) less than 15 minutes, including negative ERTs, should be reviewed with a greater level of scrutiny. The performance or non-performance of automatic notification systems should be confirmed and their effectiveness evaluated, based on the results of periodic testing thereof. The IC Team should observe operations of critical warning devices during the field inspection or at another time, if possible. Warning systems should be evaluated for their adequacy in providing timely warning; redundancy in detection and notification; and the potential for single points of failure in the warning system.

If an SFA has not been performed, the IC Team should review and comment on whether one should be performed.

16-5.4.5 **Public Safety Plan**

The IC Team shall be familiar with the current Public Safety Plan (PSP) and the warning signs, sirens, and access restrictions described therein. The IC Team is not expected to

contain a public safety expert; however, one or more members should be adequately familiar with industry standards and the FERC guidance for public safety at hydropower projects. The intent is for the IC Team to take a common sense approach to reviewing and evaluating the public safety measures that are in the immediate vicinity of project structures and/or that are directly related to standard project operations.

During the field inspection, the IC Team should take note of any devices that are missing, damaged, inoperable, or otherwise not as described in the PSP and should consider whether any new devices are warranted based on their observations. The evaluation should also consider any project-related public safety incidents that have occurred since the previous Part 12D Inspection; standard operating procedures that may have the potential to cause a hazardous situation for members of the public recreating at or near the project site (e.g., prior to operation of spillway gates, do operators view cameras of a tailrace or activate warning sirens; is warning signage at upstream recreation sites updated during high flows; the timing of installation of removable boat barriers; etc.). The findings should be documented and recommendations provided as needed.

16-5.4.6 **Operations and Maintenance Programs**

The IC Team must review records of periodic and routine maintenance activities and consider whether any are potentially indicative of underlying defects that could result in failure. This is particularly important when a certain type of maintenance activity is performed repeatedly over many years to varying degrees of success, or is often deferred due to funding or other considerations. The IC Team should review the procedures for identifying and requesting maintenance items, implementing them, recording completion, evaluating the results, and notifying appropriate regulatory agencies.

The IC Team must review the licensee's written documentation related to regular and periodic maintenance of project works, including:

- Maintenance tracking system used;
- Reports on identification, evaluation, and resolution of safety-related maintenance issues;
- Documentation of completion of maintenance items;
- Inspection checklists; and
- Other items as appropriate.

The IC Team must also review written standard procedures, including what to do in the event of floods or other emergencies. The written procedures for normal operating conditions, including coordination with upstream and downstream dams, should be compared to what the operators actually do to evaluate the accuracy and comprehensiveness of the procedures. Operator training must also be evaluated.

16-5.5 **Additional Information for the PIR**

The following sections provide details for additional information required in the PIR but not discussed previously.

16-5.5.1 **Summary of Findings and Recommendations**

The first section of the PIR is structured to allow the IC to briefly summarize the findings and recommendations provided in each of the subsequent sections of the PIR. The level of detail provided should be enough to understand the findings and conclusions but should not repeat the detailed content word-for-word.

16-5.5.2 **Project Description**

The purpose of this section of the PIR is to provide the reader with a general overview of the critical project features, methods of operation, potential failure modes, and risk. Additional information is provided below for each of the categories.

Description of Project Features

Chapter 15 of the Guidelines requires Section 2 of the STID to contain a detailed project description. Thus, a lesser level of detail is required in this section of the PIR. It is not necessary for the IC Team to completely rewrite the project description for inclusion in the Periodic Inspection Report; however, it is **not** acceptable to simply copy and paste that description without critical review and consideration of the content. The description should be in the words of the IC Team. Past dam safety incidents should be discussed as well.

Standard Project Operations

The information contained in this section should give the reader an overall understanding of how the project is operated (e.g., rule curves, seasonal restrictions, etc.) without going into too much detail on step-by-step procedures. This section should not be confused with the common phrase “standard operating procedures.”

Summary of Identified Potential Failure Modes

A basic understanding of the identified PFMs is critical; thus, the PIR is required to include a summary of the previously-identified PFMs for each project feature.

Summary of Project Risk

If a risk analysis has been completed, the PIR should include a brief summary of the project risk. The intent is to help the reader understand the primary risk drivers so they can consider the importance and value of recommendations for investigation or remediation.

16-5.5.3 **Changes Since the Previous Part 12D Report**

It is important to understand what changes have occurred since the previous Part 12D Report. The PIR provides structure for the IC(s) to document basic facts and changes to the following information:

- Modifications to project works;
- Modifications to standard project operations;
- Hydrology;
- Seismicity; and
- Studies and previous recommendations.

Modifications to Project Works and Standard Project Operations

The IC Team should focus on modifications that have an impact with respect to dam safety and/or public safety and provide a level of detail commensurate with the scale of each modification. Major modifications to project works that are generally unrelated to dam safety (e.g., a non-integral fish collection facility, recreation facilities, etc.) should be considered and listed if they have any effect on project operations and/or public safety.

Hydrology and Seismicity

In addition to providing a brief summary of the pertinent information related to hydrology and seismicity, the IC Team must review data since the previous Part 12D report to determine whether any events (i.e., storms, floods, or earthquakes) occurred that exceed the current design parameters or are otherwise inconsistent with the assumptions in the associated studies. **The purpose of this section of the PIR is not to document a detailed review of the hydrology and seismicity studies themselves; that level of review is not part of the scope of a PI.**

Status of Studies and Previous Recommendations

The IC Team must review the recommendations from prior Part 12D reports and document the status of each. The scope of this task does not extend to every Part 12D report ever filed on the project; the requirement is to review and document all recommendations from the report immediately preceding the current PI, as well as any other outstanding recommendations from any previous Part 12D reports. If all of the recommendations from the previous Part 12D report are reported to be completed, the IC Team should still review the recommendations and resolution and document whether they were addressed appropriately.

The IC Team must review, list, and document the status of any outstanding or ongoing studies related to project safety, as well as any studies related to project safety that were completed since the previous Part 12D report.

16-6 COMPREHENSIVE ASSESSMENTS

16-6.1 General

The scope of a Comprehensive Assessment is established in 18 CFR § 12.37 and comprises the following:

- A thorough review and evaluation of prior reports, including studies and analyses of record, site investigations, design reports and other documents, construction records including changes during construction, as-built drawings, the STID, dam safety incident reports (i.e., 12.10a reports), and other documentation;
- Review and evaluation of dam and public safety programs (e.g., Operations and Maintenance Program, Public Safety Plan, Owner's Dam Safety Program, etc.);
- Review and evaluation of instrumentation data and surveillance reports;
- A physical field inspection;
- Completion of a Potential Failure Modes Analysis and PFMA report;
- Completion of a Risk Analysis and the Risk Analysis Report; and
- Preparation of the Comprehensive Assessment Report.

This section provides more detail on the scope of each component of the CA along with discussion of the documentation requirements. It describes the minimum expected level of effort for preparation and performance of the CA and completion of the CAR. An outline of the CAR, which is included in Appendix 16-D, can be used as a template and rough guide for the contents of each section.

16-6.2 Review of Prior Reports

The IC Team is required "to have, at the time of the inspection under [18 CFR Part 12, subpart D], a full understanding of the design, construction, performance, condition, downstream hazard, monitoring, operation, and potential failure modes of the project works" as well as "a full understanding of the risk… associated with the project works." This requirement is established in 18 CFR § 12.37. The review of prior reports is critical and must be started well in advance of the field inspection, PFMA, and risk analysis to ensure that the members of the IC Team are able to identify and evaluate potential issues.

Based on the contents of the CA-PIPR, and how knowledgeable IC Team members are at the time of the first IC Team activity, it will be apparent whether sufficient review was performed. **If the IC Team is not adequately prepared, the FERC may require one or more IC Team activities to be performed again, at a later date, following further review of project records by the IC Team.**

A CAR is required to contain a review of both the STID and the analyses of record (18 CFR § 12.37(e) and § 12.37(a), respectively). **These are separate efforts – do not**

conflate the review of the STID with the review of the analyses themselves. The CAR includes separate sections to document:

- Review and Evaluation of Design and Construction (CAR Section 3)
- Review and Evaluation of Previous Analyses (CAR Section 4)
- Review and Evaluation of the STID (CAR Section 8.8)

Each of these items is discussed in more detail in the following sections.

16-6.3 Review and Evaluation of Design Basis and Construction

16-6.3.1 General

The importance of reviewing the design basis and project construction was explained well by both the FAAP and the Oroville IFT, which identified several features of the Oroville FCO chute design that were inconsistent with the current state-of-the-practice and the original design intent. The FAAP stated that:

> All parties involved in the Part 12 reviews/PFMA process or who are involved in remediation, operation, and maintenance should be aware of the original design and operational intent of the project components and changes made during original and subsequent construction activities.[15]

The IFT presented three questions to be answered with respect to the current state of the practice, each of which should be addressed in the CAR:

- Is the feature consistent with current design and construction practice?
- If there are variations from current practice, do they compromise the structure and present a risk of failure or unsatisfactory performance?
- If there is not enough information available to make those judgments, is the potential risk sufficient to justify further study or evaluation?[16]

The evaluation of the as-built structures requires that the IC Team understand the methods of construction and the design intent such that they can identify deviations that may affect the safety or stability of the project. For example, when conditions encountered during construction differ significantly from those assumed by the designers, often from limited field explorations, field personnel should communicate with the designers to evaluate the condition and identify an appropriate solution. If that communication does not occur or is somehow inadequate, structures can be built in a manner that is not consistent with the presumed design intent. Thus, the IC Team's comparison with respect to the design intent should be based on a thorough review of

[15] FAAP Report, page 47.
[16] IFT Report, page 76.

design basis reports, Board of Consultants (BOC) reports, construction records (e.g., photographs, progress reports, requests for information, amendments/revisions, change orders, delivery records, quality control/assurance records, etc.), and other available documentation.

The evaluation must also consider the operational intent and identify any changes that may result in the structure experiencing previously unanticipated loading conditions or otherwise lead to adverse performance. Changes to standard project operations – for example, operational changes intended to address environmental concerns such as total dissolved gases (TDG) or fish mortality, or to optimize power production – may result in loading conditions that were not intended by the original designers.

The goal is to ensure that the project features, as-constructed and operated, reflect the intent of the designers and that any unexpected conditions were addressed appropriately. For example, the foundation beneath the Oroville service spillway chute (Flood Control Outlet) was reported for many years to be hard, competent rock, but review of construction reports revealed that was not the case. The rock anchors, which were intended to resist uplift forces, were in some cases embedded into more soil-like material. Another example is the installation of energy dissipation blocks to reduce TDG, which can result in higher forces on spillways and/or reduced discharge capacity; even the spray generated by the blocks can have significant operational effects if it freezes on critical dam access routes or gate seals.

The IC Team is also expected to identify any differences between as-built and modern construction methods. For example, filter design and spillway chute detailing (reinforcing layout, joint details and foundation treatment, anchoring, drainage systems, etc.) have changed significantly over the past fifty years. Depending on the era of construction, the robustness of the design, and consequences of failure, inconsistency with the current state of the practice may not present any significant implications with respect to dam safety; however, they must be identified, evaluated, and properly documented.

16-6.3.2 **Documenting the Review**

This aspect of the review is documented in Section 3 of the CAR.

If the IC Team identifies any as-built features that are inconsistent with the design or operational intent or current state-of-the-practice, they must document the inconsistencies and evaluate the potential implications with respect to the safety and stability of project works. As with the evaluation of the studies and analyses of record, independent calculations may be required to justify the conclusions. If necessary, based on the potential risk or uncertainty, the IC Team should recommend investigations and/or analysis to address the concerns.

16-6.4 Review and Evaluation of Previous Analyses

16-6.4.1 General

The IC Team's review of the analyses must be in sufficient detail to properly evaluate the assumptions, methodologies, calculations, results, and conclusions. The IC Team must attempt to identify any differences or errors in analysis techniques and evaluate whether new analyses are warranted. The IC Team must evaluate the accuracy, relevance, and consistency with the current state of the practice of dam engineering, as described below. It is imperative that the IC Team have members qualified to review each type of analysis and perform independent calculations as needed.

Considerations for Review of Studies

When determining whether a completed study requires review by the IC Team, the status of the FERC review is irrelevant. The IC Team shall review all completed studies (i.e., those have been or are ready to be submitted to the FERC), and may be requested to review in-progress studies on a case-by-case basis. Generally, the IC Team will only be required to review studies completed by the date of the FERC approval of the IC Team.

16-6.4.2 Evaluation Requirements

The regulations specify the requirements for the evaluation of the analyses of record. The IC Team's evaluation of the "assumptions, methods, calculations, results, and conclusions" must:

- Address the **accuracy**, **relevance**, and **consistency with the current state-of-the-practice** of dam engineering;
- Be accompanied by sufficient documentation of their rationale; and shall include, as needed, new calculations by the independent consultant to verify that the assumptions, methods, calculations, results, and conclusions in the analyses of record are correct.

A list of types of studies for which this level of evaluation is required is provided below, with further discussion for those items that are specifically included in the outline of the CAR.

- Stability and stress analyses of any project feature (including embankments, concrete structures, gates, penstocks, valves, etc.);
- Seismic hazard analyses;
- PMP and PMF studies;
- Dam breach analyses, incremental hazard analyses, and IDF evaluations;
- Spillway analyses;

- Seepage and internal erosion analyses, including filter compatibility;
- Liquefaction evaluations;
- Foundation and/or abutment erosion evaluations; and
- Other relevant studies, as applicable.

Note that this is not a comprehensive list and additional studies may require such evaluation. The D2SI-Regional Engineer may occasionally provide an exemption from reviewing specific analyses on a case-by-case basis, typically based on factors such as how recent the study is and/or whether a Board of Consultants was convened to oversee it. However, in the absence of an explicit exemption, it should be assumed that all analyses of record require an in-depth review and evaluation by the IC Team.

Based on the review of each analysis of record, the CAR must contain explicit statements documenting the IC Team's conclusions regarding the accuracy, relevance, and consistency with the current state-of-the-practice. Where applicable, comparisons must also be made to criteria established elsewhere in the FERC Engineering Guidelines (e.g., sliding stability factors of safety for gravity dams are established in Chapter 3).

Accuracy

The IC Team must review the reports, analyses, and underlying calculations for errors, including invalid methodologies, use of inconsistent or incorrect parameters, mathematical mistakes, etc. The IC Team is not expected to review every calculation ever performed; however, they must perform due diligence, such as spot-checking and/or producing limited independent calculations, to ensure that the analyses of record are correct. The IC Team is not expected to be able to review every line of a finite element model input file, but they must ensure that models were set up correctly with the assumptions documented in the associated report(s), and that the output and conclusions represent the model results and are interpreted appropriately.

Relevance

The IC Team must consider whether the analyses can answer the fundamental questions they were performed to answer and identify any assumptions that may inhibit the analysis's ability to address the concerns. If an assumption or methodology prevents the analysis from providing a valid conclusion – for example, if a finite element analysis of a concrete gravity dam is intended to evaluate displacement during an earthquake, and the analyst uses a tied contact at the concrete-rock interface, thus preventing any displacement – then that analysis is not relevant. These issues must be identified to ensure that the overall conclusion with respect to dam safety is sound.

Consistency with the Current State-of-the-Practice

Analysis methods and design criteria change over time. It is important to periodically reevaluate the assumptions and methods in key analyses because, after a period of time, a

modern analysis could reach a very different conclusion. For example, consider global stability analyses for concrete gravity dams on rock foundations:

- It used to be common for stability analyses to include several hundred pounds per square inch of cohesion at the concrete-rock interface; over time, cohesion has been generally disregarded in favor of friction-only analyses.
- Rotational stability of gravity structures used to be expressed in terms of "overturning safety factors." The methodology (at the time of this writing) considers the length of a crack (non-compressive zone) along the dam-foundation interface, iterating the uplift condition to determine whether or not the crack would be expected to stabilize.

The IC Team must document the differences between the studies/analyses of record and the modern approach. The potential implications must be evaluated to a sufficient degree that the IC can make an informed conclusion as to whether the analysis remains acceptable or if further investigation or remediation may be required.

Independent Calculations

Independent calculations and/or simplified analyses may be required to justify the IC's evaluation, even if the conclusion is that the existing analyses are acceptable. For example, if a gravity dam stability analysis shows adequate factors of safety and was performed with no deviations from the current state-of-the-practice, a hand calculation may still be necessary to demonstrate that the IC Team came to a similar numerical result for a particular loading condition. In circumstances where deficiencies are identified in the existing analyses, independent calculations are generally required in order to document the potential implications of the deficiencies. **The calculations are not expected to be comprehensive or equivalent to an analysis of record.**

The IC Team must use their judgement to determine an appropriate level of independent calculations to be provided for each analysis of record. **The independent calculations must justify the IC's conclusion as to whether the existing analyses are acceptable; whether new analyses are or are not needed; and/or justify the urgency with which any new analyses should be completed.** Recommendations shall be provided for any critical deficiencies that the IC Team identifies.

16-6.4.3 **Documenting the Review**

This aspect of the review is documented in **Section 4 of the CAR**.

The required level of documentation will vary based on the type and criticality of the study or analysis being reviewed, as well as the era in which it was performed. Typically, it will not be necessary for an IC Team to reproduce a three-dimensional finite element analysis from scratch to verify stability analysis results for a concrete gravity dam; however, it is reasonable to spot-check a three-dimensional analysis using simplified two-

dimensional stability analyses. Similarly, transient pressure and penstock stress calculations are relatively straightforward and the IC Team can quickly confirm whether the conclusions are valid. The table below provides some examples of the level of confirmatory review that may be warranted. **This table should not be interpreted as strict requirements, either as a minimum acceptable or maximum required. Many types of analyses, concerns, and types of project features are not listed in the table.** The IC Team should include as much or as little as they believe represents the breadth and depth of their review.

Table 10: Analysis of Record Review Calculations (EXAMPLE)

Type of Analysis	Concern/Condition	Potential Documentation
Probable Maximum Precipitation (PMP)	Changes in relevant HMR Statewide PMP developed	Document correct HMR used Document review of watershed conditions and any changes that would affect PMP
Probable Maximum Flood (PMF)	General confirmation of PMF development	Validate basin average rainfall Validate volume of runoff and losses over the watershed (inches) Confirmation of peak inflow and hydrographs
Project hydraulics	General confirmation of project ability to pass required flows.	Confirm tailwater and spillway rating curves. Confirm availability of generating unit flow during flood events Confirm elevations of project structures Confirm wave run-up calculations
Penstock stress analyses	NDT shows significant section loss.	Calculations of stress under normal and transient conditions.

Type of Analysis	Concern/Condition	Potential Documentation
Gravity dam stability analyses	General confirmation of stability of gravity sections.	Two-dimensional stability analysis of a representative critical section of the structure Verification of design assumptions, i.e. drains needed for adequate stability and verification of effectiveness Document review of foundation investigation to confirm foundation friction angle used in analyses Documentation of zero cohesion analyses or justification of cohesion value if cohesion is used
Embankment slope stability analyses	General confirmation of embankment slope stability.	Identification of critical cross section location. Appropriate embankment zoning and foundation materials. Appropriate method of analysis. Verification of input parameters (unit weight, shear strength, water pressures, etc.). Appropriate search limits and failure surface shape employed. Are results valid?
Filter compatibility	General confirmation of internal erosion potential between various materials.	Review of construction records and boring logs to verify grain size distributions and ensure they are representative of the materials.. Filter compatibility calculations using industry accepted standards for each material boundary along flow path.

Type of Analysis	Concern/Condition	Potential Documentation
Liquefaction and deformation analyses	Ground motions increased and there are potentially continuous liquefiable layers beneath the embankment shells.	Appropriate methods used for site investigation and characterization of material properties. Appropriate method of analysis. Appropriate seismic loading selected. Verification of input parameters. Are results valid?
Radial (tainter) gates	General confirmation of structural adequacy of radial gates.	Structural analysis considering trunnion friction Review latest detailed inspection/confirm all recommendations completed or scheduled Seismic analysis of gates (if required) Confirm gate operability history (binding, AAR, hoist issues, gate chain issues, etc)

The outline of the CAR provides sections for documenting the review and evaluation of:

- Geology;
- Seismicity;
- Hydrology;
- Hydraulics of dams, spillways, other water conveyances, and dam breach studies;
- Analyses of Dams and Water Conveyances;
- Analyses of Spillway Gates, Other Gates, and Reservoir Control Devices; and
- Other relevant studies, such as erosion of abutments and/or the foundation; filter compatibility; and internal erosion and/or piping.

Additional sections should be added as needed for studies not specifically listed herein. Some specific considerations are provided below for each section listed above.

16-6.4.3.1 **Geology**

Site geology is one of the most important considerations for any project. It is important to ensure that sufficient explorations have been performed and that they have been

interpreted appropriately. Inaccurate or incomplete summaries of foundation information can have a major impact on project safety. There are many case histories that include sliding of structures along planes within the foundation, dissolution of foundation materials, movement of rock blocks, liquefaction of soil layers, etc. It is important to identify such concerns before they become dam safety issues.

The IC Team must review the available geologic information and current geologic interpretation to ensure that they are consistent. If the IC Team can make alternative interpretations from the same data, the IC Team should present the alternatives and provide recommendations that may help resolve disagreement. The review should pay particular attention to foundation material properties, foundation treatment, and how the geologic interpretation(s) may affect project structures, including structural stability, seepage, and other conditions. If the IC Team's interpretation differs from the previously accepted interpretation, the IC Team should provide recommendations for any additional information that needs to be collected to confirm or disconfirm their conclusions.

16-6.4.3.2 **Seismicity**

General project seismicity must be reviewed periodically due to the ever-changing understanding of ground motions and their effects on dams and appurtenant structures. The IC Team must review seismic sources, foundation characteristics (e.g., shear wave velocity), attenuation relationships, and other pertinent information that may affect the seismic design parameters.

16-6.4.3.3 **Hydrology**

General project hydrology must be reviewed periodically due to the ever-changing state-of-the-practice with regard to development of the Probable Maximum Precipitation (PMP), Inflow Design Flood (IDF), and/or Probable Maximum Flood (PMF). The IC Team must review the relevant studies and evaluate the parameters and methodologies, including storm selection, transposition, infiltration, snowmelt, and other pertinent information that may affect the PMP and PMF. The required level of review may vary depending on whether the IDF is the PMF.

For site-specific PMP studies, any significant storm events that occurred within the transposition limits of the project since the last review should be identified and evaluated/screened for their potential impact to the PMP.

Significant flood events that occurred since the last review should be identified and evaluated as to whether they may affect the hydrologic model for the watershed.

16-6.4.3.4 **Hydraulics**

Dams

Overall project hydraulics must be evaluated, including the loading on the dam (headwater and tailwater elevations) and the various parameters used to develop the stage-discharge curves.

Spillways

As illustrated by the Oroville spillway incident, the hydraulics of lined (and unlined) spillway chutes must be considered and evaluated to ensure safe project operation during high flow conditions. The IC Team must consider the potential for stagnation pressure, slab jacking, cavitation, scour, erosion, overtopping of side walls, and other potentially adverse conditions that may render a spillway unsafe to operate, unable to release required discharges, unstable, or otherwise present a safety risk to the project.

Other Water Conveyances

The hydraulics of other water conveyances, including canals, penstocks, flumes, tunnels, etc., must be evaluated to ensure that they are capable of conveying the expected flows. The IC Team must review the assumptions, methodologies, and findings of analyses related to hydraulic capacity and integrity of water conveyances (e.g., cavitation potential in tunnels or penstocks).

Dam Breach Studies

Dam breach studies must be reviewed periodically to ensure that Emergency Management Agencies (EMAs) have accurate inundation maps in the event of a dam safety emergency. The IC Team must review the dam breach models – including the input and output files, if possible – and evaluate the assumptions, methodologies, and results. Confirm whether inundation maps have been generated for project features that would result in significantly different inundation limits and/or consequences than the primary structure.

16-6.4.3.5 **Stress and Stability**

Each stress and stability analysis of record must be reviewed. In general, the list of analyses reviewed should match the list of analyses discussed in Section 8 of the STID. If the review identifies project features for which there are no available stress or stability analyses of record, or if the analyses of record are fundamentally flawed, the IC Team must consider whether to perform independent calculations as part of the CAR or simply recommend the completion of new analyses. Some questions that should be answered include:

- Will the analysis address a concern related to credible identified PFM?
    - If so, is the PFM classified as “credible and urgent”?

- Do any visual observations or instrumentation data suggest that there is an active or developing PFM or other performance issue which could be evaluated by the analysis?
- Do the FERC Engineering Guidelines require the analysis to exist? (For example, any concrete gravity section must be evaluated for stability while not all penstocks require a stress analysis for transient loading.)

Depending on the answers to the above questions, the IC(s) should include independent calculations with the CAR. Otherwise, they should recommend new analyses and a suggested schedule for completion.

16-6.4.3.6 **Erosion of Abutments and/or the Foundation**

The IC Team must review any studies related to the erodibility of foundation or abutment material. Potential sources of erosion include normal or excessive releases from spillways and valves, overtopping or outflanking of project structures, and breaches of penstocks or other water conveyances.

16-6.4.3.7 **Internal Erosion and Filter Compatibility**

The IC Team must review any evaluations of filter compatibility involving embankment zones and the foundation. Material gradations should be reviewed to ensure the appropriate procedures were followed for the material types and that filter evaluations were based on representative information. As-constructed material gradations should be used when available rather than relying on design gradations. The full range of gradations should be used for each material type in the analyses, not just the average or mean gradation. Filter compatibility should be evaluated for each material boundary along potential flow paths in, along, and through the embankment and foundation.

16-6.4.3.8 **Overtopping**

The IC Team must review and evaluate overtopping analyses for dams, other structures, and the abutments thereof that may be subjected to overtopping; this includes evaluations of the overtopping itself (e.g., over the crest of an embankment dam, a low-lying natural feature, etc.) as well as jet impact on abutments or the foundation. When abutments or the foundation comprise more than one type of material along the length or height, the IC Team must consider each area that may be affected or impacted by flowing or falling water, the potential for each to erode, and the potential consequences.

16-6.4.3.9 **Other Studies**

The IC Team must review and evaluate other studies as applicable to the project under consideration. Typically, the Part 12D Inspection Reminder Letter issued by the FERC-RO will list specific studies of concern, though the general rule is that if a study has been or should be summarized in the STID, it should be reviewed and evaluated by the IC Team.

16-6.5 Review of the STID

16-6.5.1 General

Previously, the Part 12D guidance conflated the review of the STID with the review of the analyses of record. Now, the purpose of the IC Team review of the STID is more clearly stated:

- Evaluate whether the information in the hard copy STID accurately represents the source material;
- Evaluate whether the STID fulfills the requirements of Chapter 15 of the Guidelines; and
- Evaluate whether the STID is sufficiently comprehensive to be useful in the event of a dam safety emergency and during future project reviews (e.g., subsequent CAs and PIs).

The depth of review of the STID should be commensurate with those goals.

16-6.5.2 Documenting the Review

This aspect of the review is documented in Section 8.8 of the CAR.

For each section of the STID, the CAR must include a clear statement that the IC Team reviewed the information, along with the findings and any recommendations. The IC Team shall document any recommended updates to the hard copy STID as well as any deficiencies in the comprehensiveness of the digital reference. Section 1 of the STID (Potential Failure Modes Analysis Report and Risk Analysis Report) is a special case – refer to Section 16-6.6.4 of this Guideline.

16-6.6 Potential Failure Modes Analysis and Risk Analysis

16-6.6.1 General

This aspect of the review is documented in Section 7 of the CAR. Limited information is provided in this Guideline; refer to Chapters 17 and 18 for additional details regarding PFMAs and RAs, respectively. Depending on who facilitates the PFMA/RA and prepares the PFMA Report/RA Report, the IC's responsibilities vary with respect to the CAR; refer to Section 16-6.6.4 for details. As discussed in Section 16-3.3.2.1, the licensee should carefully consider the role of the IC(s) in conducting and documenting the PFMA and RA.

16-6.6.2 Potential Failure Modes Analysis

18 CFR § 12.37(f) requires that the CA include a PFMA, which is one of the most critical aspects of a CA.

Required Activities for a Comprehensive Assessment PFMA

The PFMA during a CA comprises more than a review of the previous PFMA Report. **Each PFMA must draw from the knowledge, experience, and creativity of the personnel present, who will vary from PFMA to PFMA.** Chapter 17 of the Guidelines provides a significant amount of information regarding the process, qualifications, best practices, and other useful information for performing a PFMA. With respect to a CA, a PFMA must follow these steps:

- Begin each PFMA with a brainstorming session that discusses each project feature and the ways in which it could fail under various loading conditions. **During the brainstorming session, the PFMA team – including the facilitator and any other participants – must not refer to any previous PFMA Report or a prepared list of common PFMs.** Members of the PFMA team should do all necessary preparatory work ahead of the PFMA, including reviewing background information and taking note of any ideas for candidate PFMs.
- **After the brainstorming is complete for every project feature**, the team may refer to the previous PFMA Report(s) and/or prepared lists of common PFMs to identify items that were overlooked or to fill in gaps in the brainstormed information. It is important not to refer back to prior materials until the brainstorming is complete because if the team does not identify a particular PFM, their motivation or confidence may be adversely affected. **The result of this step is a list of candidate PFMs to be screened.**
- For each candidate PFM, the PFMA team completes the description, evaluation, and screening processes, though it will be slightly different depending on whether the candidate PFM was previously identified:
    - For brainstormed PFMs that were previously identified and documented in a prior PFMA Report, the PFMA team may use the existing documentation as a guide. The PFMA team reviews the existing documentation as a group; evaluates the information provided in each section of the PFM description; makes any necessary updates; and screens the PFM.
    - For candidate PFMs not previously identified, the PFMA team follows the steps to describe and screen the PFM, as documented in Chapter 17.

Documenting the Comprehensive Assessment PFMA

The findings of the CA PFMA must be documented in a PFMA Report, the format of which is discussed in Chapter 17 of the Guidelines. Each PFMA Report contains a significant amount of information and requires a great deal of effort to prepare, review, and finalize. If the information contained in the previous PFMA Report was accurate – and relevant facts, conditions, and the state of the practice have not changed – the existing documentation may still be applicable. **Thus, the PFMA Report does not have**

to be written from scratch for each CA. However, the PFMA team must critically review all of the information during the process described above.

If a previous PFMA Report is used as the basis for compiling the new PFMA Report, the PFMA team must ensure that it is consistent with the most recent guidance available in Chapter 17 of the Guidelines. In addition, by using the previous PFMA Report as the starting point for the new PFMA Report, **the party responsible for preparing the PFMA Report takes ownership of the entire PFMA Report,** not just the updates/revisions to the PFMA Report.

16-6.6.3 **Risk Analysis**

Unless a written exemption is provided in advance by the Regional Engineer, 18 CFR § 12.37(g) requires a CA to include an RA. Chapter 18 of the Commission's Engineering Guidelines provides additional details regarding the scope and performance of a semi-quantitative risk analysis as part of a CA.

16-6.6.4 **Requirements for Review and Evaluation**

There are special considerations related to the review of the PFMA Report and RA Report. With regard to most aspects of the CA, the IC is expected to review and evaluate the work of others (e.g., analyses of record, STID, special inspection reports, etc.). The PFMA and RA are such integral parts of the CA that a licensee may develop a scope of work that tasks the IC Team with performance of the PFMA and/or RA and preparation of the report(s) thereon.

If the IC Team *is responsible* for performance and preparation of either the PFMA Report or RA Report, it is unnecessary for the IC to evaluate that report separately since preparation of either report implies that the IC is in concurrence with the contents. Thus, the CAR outline contains separate information requirements depending on whether the PFMA and/or risk analysis report was prepared by the IC Team or another party.

If the IC Team *is not responsible* for performance and preparation of either the PFMA report or RA report, they will be expected to thoroughly review, evaluate, and comment on the report(s). The IC has the discretion to emphasize or de-emphasize any of the "team findings" presented in the PFMA or RA report(s). It also allows for incorporation of any new information, results of analyses, or other findings that may have come to light during the IC's inspection and report. The IC will be expected to verify the accuracy of information in the report(s) and provide recommendations for updating information, changing PFM dispositions, risk estimates, etc.

If as a result of the detailed inspection, the IC finds new or varying information or has a professional opinion that necessitates revision of the findings of the PFMA or RA, the IC would provide the licensee with the appropriate revisions as a supplement to the related report. For example, the IC would prepare a fully developed revised PFMA description as

a supplement to the PFMA report, or a revised risk estimate as a supplement to the RA report. After completion of FERC review and acceptance of the supplement, the licensee would then provide copies to all holders of the STID with a request to append the supplement to the PFMA and/or RA report. The licensee's cover letter transmitting the revision to the PFMA and/or RA report should discuss the reason for the revision including who developed the supplemental PFMA and/or RA and its potential impact on project safety. That "updated" PFMA and/or RA would then be the foundation for the next Part 12D Independent Consultant inspection report.

16-6.7 **Observations and Evaluations of Performance**

This section of the CAR has been structured to help ensure that findings are thoroughly documented and evaluated for each project feature. Four headings, listed below, are required for each project feature.

Field Inspection Observations

Review and Evaluation of Instrumentation Data and Surveillance Reports

Evaluation with Respect to Potential Failure Modes

Conclusion

The evaluation of PFMs for each feature must consider both the field inspection findings and an independent interpretation of instrumentation data and surveillance reports. **It is not acceptable to rely entirely on previous interpretations, nor is it acceptable to state that instrumentation data does not indicate a potential issue simply because it is not changing over time.**

The CAR must include a discussion of the field observations relative to each of the identified potential failure modes as well as the Independent Consultant's own assessment of the significance of the identified potential failure modes; whether any other (previously unidentified) potential failure modes may exist; and conditions that have changed and may impact previous conclusions regarding potential failure modes. The CAR must provide sufficient documentation to support whatever the stated conclusion is with respect to each identified PFM and the overall suitability of the feature for continued operation.

The overall conclusion for each project feature should be clear and based on the discussion that precedes it. It is not necessary to reiterate information as long as the rationale is apparent from the preceding discussion. The requirements of physical field inspection and review of instrumentation data and surveillance reports are discussed below.

16-6.7.1 **Physical Field Inspection**

The requirement for a physical field inspection is established in 18 CFR § 12.37(b). The physical field inspection must include a detailed visual observation of all physically accessible project features by one or more members of the IC Team. Each portion of the inspection should be observed by at least one Independent Consultant, plus any members of the IC Team qualified to evaluate that type of project feature (e.g., a structural engineer should not be the primary inspector for an embankment dam). The Bureau of Reclamation Safety Evaluation of Existing Dams (SEED) Manual may be used as a reference for general procedures related to the inspection of dams and project works.

The IC Team must inspect the reservoir rim during a Comprehensive Assessment to evaluate any credible PFMs and, if there are none, whether any new conditions could warrant reevaluation of previously dismissed (excluded or ruled out) PFMs. While it may be sufficient to observe the reservoir solely from the dam crest during a Periodic Inspection, it will likely require greater attention during a Comprehensive Assessment. The scope of the reservoir rim inspection must be sufficient to observe all areas that could contribute to the initiating conditions in any identified PFMs, regardless of whether the PFMs are considered credible or not. In some cases it may be preferable for the inspection to occur from a boat or aircraft, though inspections from the ground may suffice. Drone video or recent satellite imagery may also be used, though satellite imagery must be recent and not have potentially critical areas obscured by cloud cover. The IC Team should ensure that the methods they use to perform the reservoir rim inspection are sufficient for confirming facts and conditions related to relevant PFMs (e.g., surveys may be helpful for evaluating low spots in generally flat areas that may overtop during floods or as a result of a seiche).

Spillway chutes, whether lined or unlined, should be inspected up close to the extent possible. The FERC recognizes that some spillways are too steep to be inspected without extensive preparation, and that in some cases a licensee or IC Team may choose to have only a specially-trained (e.g., rope access) team perform the inspection for safety considerations. In that case, it may be acceptable for the IC Team to review a detailed inspection report (e.g., a focused spillway assessment report) prepared by another qualified party within the previous year. It is preferred that one or more members of the IC Team at least observe the special inspection. The Regional Engineer may provide additional requirements related to the spillway chute inspection in the inspection reminder letter.

If possible, the relevant members of the IC Team should observe full-height spillway gate test operations. In many cases, this may require significant coordination (e.g., placement of dewatering bulkheads, a low reservoir, preexisting high flows to limit downstream effects, etc.). If circumstances do not permit the observation of full-height gate tests, the IC Team still must observe test operations of a representative number of gates such that

they can evaluate the gate performance, licensee's standard operating procedures, and provide informed conclusions.

The test operations must include use of the primary hoist equipment and, if possible, backup lifting procedures. For any traveling (shared) hoists, the tests must include the full procedure to operate at least two gates; for example:

- Open and close gate #1;
- Detach traveling hoist from gate #1;
- Move traveling hoist to gate #2;
- Attach traveling hoist to gate #2; and
- Open and close gate #2.

Every power source available for operation of gates must be tested and used to operate a gate during the inspection. If there are multiple backup power sources – for example, a diesel-powered generator, a portable propane-powered generator, and a battery bank – each should be used. If the licensee's standard operating procedures include other emergency methods for operating a gate – such as a using a lifting beam and portable crane, or attaching a hand crank – the IC Team should confirm that the required equipment is available and that licensee staff are sufficiently familiar with the procedures. Demonstration of gate operation using these procedures is optional but may be recommended based on the criticality to project safety.

The IC Team shall review all reports on special inspections that have occurred since the previous Comprehensive Assessment or within the preceding ten years, whichever period is longer. Some examples of special inspection reports are:

- Underwater inspections;
- Hands-on gate inspections;
- Focused spillway assessments;
- Special access inspections (confined space, rope access, etc.), including of penstocks and tunnels;
- Camera scope inspections of drains, conduits, and other features;
- Aerial drone inspections; and
- Other inspections as applicable.

Appropriate provisions shall be made to enable the IC Team and FERC staff to inspect typically inaccessible features or those that require special provisions (e.g., confined spaces), except those that are adequately covered by a special inspection report that will be reviewed and evaluated by the IC Team.

16-6.7.2 **Review of Instrumentation Data and Surveillance Reports**

The requirement to review surveillance and monitoring data is established in 18 CFR § 12.37(c). **This is a critical component of the Comprehensive Assessment and is equally important as the field inspection**. Previous dam safety incidents may have been avoided, or the urgency of response and remediation reduced, had the instrumentation data been reviewed with more careful consideration.

The review of monitoring data must be a critical, thorough review of the data itself. It is not acceptable for the IC Team to review only the instrumentation data plots prepared by the licensee and included in the annual DSSMR submittal. The licensee must provide the IC Team with all available data such that the IC Team can identify, describe, and evaluate:

- Relationships between instrument readings and environmental factors such as reservoir elevation, precipitation, air/water temperature, project operations, etc.;
- What constitutes expected behavior for each instrument (and, by extension, what constitutes unexpected behavior);
- Whether there are any historic readings or ongoing trends that may indicate adverse behavior; and
- Whether any established thresholds, automated alarms, etc. are set such that they will trigger appropriate follow-up actions prior to substantial progression of a potential failure mode.

The IC Team must review surveillance reports to supplement their field inspection observations. The findings of previous inspections should be compared to the current findings, with discrepancies and changes in performance noted.

In order to properly complete this aspect of the CA, the IC Team must understand the purpose, function, and expected behavior of each instrument or feature. It is not sufficient to simply identify trends or threshold exceedances, or the lack thereof. It is not acceptable to rely entirely on a previous interpretation or to state that data is acceptable simply because the behavior is consistent over time. The IC Team must thoughtfully consider each instrument and surveillance report; describe the expected behavior of each; and identify any observations or data that is unexpected or indicative of adverse performance. Statistical analysis may be required for complex, heavily-instrumented projects or large data sets. **It is not acceptable to state that previous evaluations did not identify any problems, that no changes in behavior were identified, and thus the data is acceptable.** The documented rationale may refer to previous evaluations but must not rely on them.

The IC Team should consider collecting manual readings of critical monitoring instruments (e.g., piezometers, crack gages, plumblines, etc.) during the field inspection.

This provides valuable information about the condition of the project at the time of the inspection. It also gives the IC Team an opportunity to review the licensee's manual data collection procedures. Any readings collected should be noted and evaluated in this section.

16-6.8 Review and Evaluation of Dam and Public Safety Programs

The requirement for review of dam and public safety programs is established in 18 CFR § 12.37(d); the review of the DSSMP is required by 18 CFR § 12.37(c). In each section, the CAR must include a clear statement that the IC Team reviewed the information, along with any findings and recommendations. Some additional considerations are discussed below.

This aspect of the review is documented in **Sections 8.1 through 8.6 of the CAR**.

16-6.8.1 Owner's Dam Safety Program

Although the licensee may opt to have the IC Team review the ODSP, the IC Team is not required by the FERC to perform a detailed review of the written ODSP document or conduct extensive, focused interviews with project staff. The FERC requires only that the IC Team be sufficiently familiar with the written ODSP and the FERC guidance thereon that they are able to evaluate whether it is being implemented appropriately with respect to the project being inspected.

During preparation and performance of the CA, the IC Team should take note of any actions, requests, responses to unusual events, or other situations that may indicate licensee staff do not strictly adhere to the tenets espoused in the written ODSP. These should be noted in the CAR; if there are no such situations, that should be stated.

16-6.8.2 Performance Monitoring Program (Surveillance and Monitoring)

The IC Team must be familiar with the written protocols for surveillance of the project works, including any inspection checklists the licensee maintains, which are typically documented in a Dam Safety Surveillance and Monitoring Plan. It is important to understand the layout of existing instrumentation as well as the installation details, function, performance, and reading frequency/procedures (both manual and automated). The depth of review must be sufficient so the IC Team:

- Understands the function and purpose of each instrument and surveillance procedure;
- Knows what observations or recorded data may indicate the onset or progression of a PFM, or conditions that are otherwise out-of-the-ordinary with respect to general health; and
- Can make informed recommendations for improvements (e.g., new instrumentation, changes to procedures, etc.).

The evaluation must consider both the surveillance procedures and instrumentation and their effectiveness at monitoring for the identified PFMs as well as general health. For each PFM, the IC Team must review whether the monitoring program is adequate to detect the onset of the PFM, or conditions that may contribute to or "allow" development of the PFM, in a timely manner. The ICs should provide comments that relate historic and current performance indicators (i.e., monitoring data) to identified PFMs. The ICs should also address whether the instrumentation at the dam is functioning properly and is adequately maintained.

The ICs should specifically consider whether inspections during unusual conditions (e.g., high pool elevations not previously experienced, seismic events, etc.) or related to inaccessible features are of an appropriate scope and performed at an appropriate frequency.

The IC Team must also review procedures for and the timing of licensee engineering review (e.g., data reduction and analysis) of instrumentation data and surveillance reports, and any reporting of adverse or unusual findings to more senior personnel for investigation or other action.

16-6.8.3 **Hazard Potential Classification**

Hazard potential classifications are defined in 18 CFR § 12.3 and Chapter 1 of the Engineering Guidelines. The IC Team is required to review the conditions upstream and downstream of a project to evaluate:

- Whether the current hazard potential classification is appropriate, and
- Whether any changed conditions warrant reconsideration of the sudden failure assessment (SFA) or other procedures in the Emergency Action Plan.

The IC Team shall review the conditions upstream and downstream of project structures and take note of any changes to development (e.g., a significant increase in the population at risk, new developments below structures classified as low or significant hazard, or new structures closer to the project than those previously identified). When evaluating whether the hazard potential classification remains appropriate, the IC Team should also consider the effects that failure may have on environmental and cultural resources; critical infrastructure, such as major highways and municipal water supplies; and other conditions as applicable.

Note that significant changes in the population at risk or other consequences (i.e., an order of magnitude or more) can affect the conclusions of the Risk Analysis.

A visual review is preferred but in some cases, conversations with the licensee and a review of aerial or satellite imagery can suffice. It is important to note the date of publicly available imagery, as it can be out-of-date in remote areas. Conversations with

licensee staff regarding changes to downstream development should be documented. The findings must be documented in the CAR and appropriate recommendations provided.

16-6.8.4 **Emergency Action Plan**

Typically, no members of the IC Team will be required to have specialized experience in emergency response procedures. However, an EAP is such an important component of a dam safety program that the IC Team must have sufficient general knowledge to review and comment on it. There may be cases in which emergency response personnel would be appropriate to include as part of the IC Team.

If the project is subject to 18 CFR Part 12, Subpart C, the IC Team must review the EAP, including the inundation maps (the review of dam breach analysis is discussed separately, as a component of the review of the hydraulic analyses of record). The review shall consider the written EAP document as well as the licensee's training procedures, coordination with outside persons and agencies, and the familiarity of project staff with their roles and responsibilities.

If any EAP activations or functional/full-scale exercises have occurred since the previous Part 12D Report, the IC Team must review and evaluate the after-action report and licensee's plan of action.

If a Sudden Failure Assessment (SFA) has been performed for the project, the IC Team must review the assumptions, procedures, and evaluate the findings. Any project with an excess response time (ERT) less than 15 minutes, including negative ERTs, should be reviewed with a greater level of scrutiny. The performance or non-performance of automatic notification systems should be confirmed and their effectiveness evaluated, based on the results of periodic testing thereof. The IC Team should observe operations of critical warning devices during the field inspection or at another time, if possible. Warning systems should be evaluated for their adequacy in providing timely warning; redundancy in detection and notification; and the potential for single points of failure in the warning system.

If an SFA has not been performed, the IC Team should review and comment on whether one should be performed.

16-6.8.5 **Public Safety Plan**

The IC Team shall be familiar with the current Public Safety Plan (PSP) and the warning signs, sirens, and access restrictions described therein. The IC Team is not expected to contain a public safety expert; however, one or more members should be adequately familiar with industry standards and the FERC guidance for public safety at hydropower projects.

During the field inspection, the IC Team should take note of any devices that are missing, damaged, inoperable, or otherwise not as described in the PSP and should consider whether any new devices are warranted based on their observations. The evaluation should also consider any project-related public safety incidents that have occurred since the previous Part 12D Inspection; standard operating procedures that may have the potential to cause a hazardous situation for members of the public recreating at or near the project site (e.g., prior to operation of spillway gates, do operators view cameras of a tailrace or activate warning sirens; is warning signage at upstream recreation sites updated during high flows; the timing of installation of removable boat barriers; etc.). The findings should be documented and recommendations provided as needed.

16-6.8.6 **Operations and Maintenance Programs**

The IC Team must review records of periodic and routine maintenance activities and consider whether any are potentially indicative of underlying defects that could result in failure. This is particularly important when a certain type of maintenance activity is performed repeatedly over many years to varying degrees of success, or is often deferred due to funding or other considerations. The IC Team should review the procedures for identifying and requesting maintenance items, implementing them, recording completion, evaluating the results, and notifying appropriate regulatory agencies.

The IC Team must review the licensee's written documentation related to regular and periodic maintenance of project works, including:

- Maintenance tracking system used;
- Reports on identification, evaluation, and resolution of safety-related maintenance issues;
- Documentation of completion of maintenance items;
- Inspection checklists; and
- Other items as appropriate.

The IC Team must also review written standard procedures, including what to do in the event of floods or other emergencies. The written procedures for normal operating conditions, including coordination with upstream and downstream dams, should be compared to what the operators actually do to evaluate the accuracy and comprehensiveness of the procedures. Operator training must also be evaluated.

16-6.9 **Evaluation of Spillway Adequacy**

16-6.9.1 **General**

The basic requirements for the evaluation of spillway adequacy are defined in 18 CFR § 12.39 of the Commission's regulations. The IC Team must also identify and address the

effects of the overtopping of non-overflow structures. This aspect of the review is documented in Section 8.7 of the CAR.

16-6.9.2 **Conditions Affecting Spillway Capacity**

The IC Team must consider the potential to occur, and effects of, abnormal conditions that may reduce the usable discharge of the spillway below its rated discharge capacity. 18 CFR § 12.39(a)(3) lists four types of situations that must be specifically evaluated in the Comprehensive Assessment Report. Each category is discussed in more detail below. Other conditions not listed below should be considered, as appropriate.

Misoperation

Misoperation of gates, valves, and other discharge devices generally refers to situations such as jammed gates, gates that open more slowly or later than planned, or gates operated in a manner inconsistent with the standard protocols, resulting in adverse conditions. For example, if there is a gate operation protocol for a total of 'X' feet of opening based on the headwater elevation, and a staffing shortage results in late operations and a total opening significantly less than required, the peak reservoir elevation may be higher than it would have been had the gates been operated normally. Misoperation also includes situations in which a person takes actions that deviate from the required procedure, due to inadequate training, confusion, a simple mistake, or an operator's personal concerns that their action to increase discharge may result in flooding downstream.

Failure to Operate

Failure to operate can be seen as an extreme case of misoperation: instead of operating slower or not as scheduled, the device does not operate at all. The resulting lack of discharge may result in a surcharged reservoir. Some examples of "failure to operate" types of situations are listed below:

- When instructed to open or close via a SCADA system, push of a button, etc., a gate or valve simply does not respond;
- The equipment required to operate the feature (e.g., a traveling hoist) is out of service or otherwise nonfunctional;
- Gates or valves are sealed shut due to the accumulation of ice;
- Broken lifting equipment, such as wire ropes, chains, or their attachment points to a gate; or
- Primary power is unavailable and the fuel supply for the backup system is corrupted or empty.

This condition also applies to tripped devices, such as flashboards, which may be designed with components that are supposed to fail under a certain load (e.g., a surcharge

reservoir elevation). If the designed-to-fail components are built out of specification – the diameter is too large or the material is too strong, for example – the devices may not trip and total discharge will be less than intended. Erodible fuse plugs are also susceptible to this type of situation due to material gradation, compaction, frozen ground, vegetation growth, pilot channel elevation, etc.

Blockage

Debris blockage of spillways and/or reservoir control valves has occurred in the past and is a common potential failure mechanism at many projects. The IC Team shall evaluate the type of debris typical in the reservoir, whether that is representative of the debris to be expected during flood events, the potential for such debris to block discharge pathways, and the effect that may have on the reservoir elevation. The IC Team shall consider the potential for the failure of debris collection booms, which may result in significant debris mats arriving at a spillway all at once instead of in smaller, more manageable quantities.

Debilitating Damage

Perhaps the most well-known recent example of debilitating damage to a spillway affecting the reservoir elevation is what occurred at Oroville Dam in early 2017. The Oroville IFT Report offers far more detail on the situation than this Guideline; suffice it to say that limiting discharge through the Flood Control Outlet (FCO) to mitigate the potential for further damage to the spillway chute may have surcharged the reservoir to the point that the auxiliary spillway (also referred to as the "emergency spillway") activated. While licensee actions during hypothetical situations cannot be predicted reliably, it is useful to discuss the potential for such a situation and what options the licensee would have for managing it.

16-6.9.3 **Consequences of Inadequate Capacity**

In addition to discussing how the spillway capacity could be affected, the CAR must include an evaluation of the effects thereof. Some questions that could be answered include:

- What frequency of flood could be passed safely (e.g., without reservoir surcharge, without overtopping, etc.) if one gate were unavailable? Two gates?
    - Gate unavailability should be consistent with the postulated cause. At a project with ten gates, random failure of operating equipment may realistically affect only one gate at a time; however, an earthquake disabling unanchored hoist equipment may affect every gate.
- How reliable are the operating equipment and power sources? What does historic data show with respect to jamming and/or failure-to-operate?

- How much discharge capacity could be lost due to debris plugging? Could a local surcharge result in overtopping of an erodible structure, or prevent access to or damage gate operation equipment?

Some of these questions assume that the project is able to pass the IDF/PMF without overtopping. If a project feature is assumed to overtop even with all discharge devices at full capacity, the evaluation of the effects of inadequate capacity must consider the magnitude of increase in overtopping as well as the effect that would have on the project structures.

16-6.9.4 **Documenting the Review**

The CAR is required to include a narrative discussion of the IC Team's review and evaluation of each of the four conditions listed above, as well as any other potential conditions that may result in a reduction of spillway capacity.

16-6.10 **Additional Information for the CAR**

The following sections provide details for additional information required in the CAR but not discussed previously.

16-6.10.1 **Summary of Findings and Recommendations**

The first section of the CAR is structured to allow the IC to briefly summarize the findings and recommendations provided in each of the subsequent sections of the CAR. The level of detail provided should be enough to understand the findings and conclusions but should not repeat the detailed content word-for-word.

16-6.10.2 **Project Description**

The purpose of this section of the CAR is to provide the reader with a general overview of the critical project features, methods of operation, potential failure modes, and risk. Additional information is provided below for each of the categories.

Description of Project Features

Chapter 15 of the Guidelines requires Section 2 of the STID to contain a detailed project description. Thus, a lesser level of detail is required in this section of the CAR. It is not necessary for the IC Team to completely rewrite the project description for inclusion in the Comprehensive Assessment Report; however, it is **not** acceptable to simply copy and paste that description without critical review and consideration of the content. The description should be in the words of the IC Team. Past dam safety incidents should be discussed as well.

Standard Project Operations

The information contained in this section should give the reader an overall understanding of how the project is operated (e.g., rule curves, seasonal restrictions, etc.) without going

into too much detail on step-by-step procedures. This section should not be confused with the common phrase "standard operating procedures," which should be discussed in the review of the associated section of the STID (Section 8.8.4 of the CAR).

Summary of Identified Potential Failure Modes

A basic understanding of the identified PFMs is critical; thus, the CAR is required to include a summary of the previously-identified PFMs for each project feature.

Summary of Project Risk

If a risk analysis has been completed, the CAR should include a brief summary of the project risk. The intent is to help the reader understand the primary risk drivers so they can consider the importance and value of recommendations for investigation or remediation.

16-6.10.3 **Changes Since the Previous Part 12D Report**

It is important to understand what changes have occurred since the previous Part 12D Report. The CAR provides structure for the IC(s) to document basic facts and changes to the following information:

- Modifications to project works;
- Modifications to standard project operations;
- Hydrology;
- Seismicity; and
- Studies and previous recommendations.

Modifications to Project Works and Standard Project Operations

The IC Team should focus on modifications that have an impact with respect to dam safety and/or public safety and provide a level of detail commensurate with the scale of each modification. Major modifications to project works that are generally unrelated to dam safety (e.g., a non-integral fish collection facility, recreation facilities, etc.) should be considered and listed if they have any effect on project operations and/or public safety.

Hydrology and Seismicity

In addition to providing a brief summary of the pertinent information related to hydrology and seismicity, the IC Team must review data since the previous Part 12D report to determine whether any events (i.e., storms, floods, or earthquakes) occurred that exceed the current design parameters or are otherwise inconsistent with the assumptions in the associated studies. **The purpose of this section of the CAR is not to document a detailed review of the hydrology and seismicity studies themselves; that information is to be provided elsewhere in the CAR.**

Status of Studies and Previous Recommendations

The IC Team must review the recommendations from prior Part 12D reports and document the status of each. The scope of this task does not extend to every Part 12D report ever filed on the project; the requirement is to review and document all recommendations from the report immediately preceding the current CA, as well as any other outstanding recommendations from any previous Part 12D reports. If all of the recommendations from the previous Part 12D report are reported to be completed, the IC Team should still review the recommendations and resolution and document whether they were addressed appropriately.

The IC Team must review, list, and document the status of any outstanding or ongoing studies related to project safety, as well as any studies related to project safety that were completed since the previous Part 12D report.

16-7 FOLLOW-UP AND CORRECTIVE MEASURES

16-7.1 General

The requirement to submit a plan and schedule to address the Independent Consultant's recommendations is established by 18 CFR § 12.41. The plan and schedule must be submitted within 60 days of the date the report is filed with the Regional Engineer.

In addition to the IC's recommendations, include a table documenting any identified risk reduction measures associated with PFMs classified as "urgent" or "credible," along with the licensee's plan and schedule for implementation.

16-7.2 No Action and Alternatives

A licensee is not required to carry out a recommendation or risk reduction measure simply because an Independent Consultant has recommended it. However, adequate justification must be provided in the plan and schedule for any recommendation or risk reduction measure for which the licensee proposes no action or an alternative. The level of justification required will vary depending on the criticality of the recommendation or risk reduction measure; it may be as simple as a paragraph expressing disagreement and stating that it has no dam safety benefit, or it may require detailed analysis.

If a licensee intends to propose no action or a substantially different alternative, they should discuss it with both the IC and the FERC after the report is filed but prior to submittal of the plan and schedule. Any proposal for no action or an alternative action must be reviewed and accepted by the FERC prior to implementation. The FERC may still require the licensee to complete recommendations provided by the IC or risk reduction measures regardless of any justification provided by the licensee.

16-7.3 Emergency Corrective Measures

Special provisions related to emergency corrective measures are discussed in 18 CFR § 12.41(b), which requires that the IC immediately notify the licensee and the licensee report the condition to the Regional Engineer, pursuant to 18 CFR § 12.10(a). Thus, any condition which is a "condition affecting the safety of a project or project works," as defined in 18 CFR § 12.3, requires emergency corrective measures.

While emergency corrective measures will likely be addressed on a timeline faster than non-emergency corrective measures, they must still be documented in:

- The PIR/CAR;
- The licensee's plan and schedule to address the IC's recommendations; and
- Periodic updates, described in the subsequent section.

16-7.4 **Periodic Updates**

The licensee shall prepare and maintain a status report of all of the Independent Consultant's recommendations, in accordance with 18 CFR § 12.41. At least once per year – either as a standalone submittal, an attachment to the annual DSSMR, or in advance of the FERC dam safety inspection – the status report must be submitted to the Regional Engineer. Any changes to the plan and schedule that have not previously been proposed to and accepted in writing by the Regional Engineer must be identified and justified in the cover letter and explicitly requested by the licensee.

16-7.5 **Comprehensive Assessment Review Meeting**

Within 60 days after the CAR is submitted by the licensee to the FERC, the IC Team is required to present a summary of their findings, conclusions, and recommendations to the licensee and the FERC. A typical meeting agenda is included in Table 8.

Table 8: Typical Comprehensive Assessment Review Meeting Agenda

Item	Topic	Lead	Duration
1	Introductions	FERC	5 min
2	Opening Statements	FERC Licensee/IC	5 min 5 min
3	Comprehensive Assessment Summary Presentation	IC(s)	30-45 min
4	Questions from FERC Review Team	FERC	20-30 min
5	Summary of Follow up Activities, if any	FERC	0-10 min
6	Concluding Remarks	Licensee/IC FERC	5 min 5 min
7	Adjourn		

A brief outline of the information required to be discussed in the CA Review Meeting Presentation is included as Appendix 16-F.

The review meeting may take place in person or remotely (e.g., via videoconference, teleconference, or webinar), as dictated by time, location, and other considerations.

Scheduling, coordination, and logistics (webinar/call in information) of the review meeting shall be provided by the Licensee or IC. The meeting will be led by a FERC representative. Depending on the size and complexity of the project, it is anticipated that the meeting will last less than two hours.

A review meeting is not required after submittal of a PIR, unless directed by the D2SI-Regional Engineer.

APPENDIX 16-A OUTLINE FOR THE PART 12D INSPECTION PLAN

This appendix provides a brief outline for a Part 12D Inspection Plan, which is to be submitted by the licensee to the FERC in advance of a Part 12D Inspection (Comprehensive Assessment or Periodic Inspection) for review and evaluation by the FERC. The Part 12D Inspection Plan must be accepted by the FERC in order for the inspection to proceed.

Cover Letter

1. Project Information
   - List the Project Name, FERC Project Number, and state(s)
   - Identify the type of inspection (Comprehensive Assessment or Periodic Inspection) and whether it includes a Risk Analysis (for a CA only).
   - Provide a brief description of the project features to be inspected.
2. Independent Consultant Team Proposal
   a. Identification of Technical Disciplines Required
   Include information formatted similar to the example table below, as discussed in Section 16-3.3.2.1.

IC Team Technical and Expertise Requirements		
Project Feature	**Relevant Technical Disciplines**	**Issues/Technical Complexity**

   b. Proposed Independent Consultant Team
   Include information formatted similar to the example table below, as discussed in Section 16-3.3.2.2.

Name	**Role**	**Technical Discipline(s)**

3. Schedule
   Include the information discussed in Section 16-3.3.3.

Attachments

Resumes

Include resumes for the proposed IC(s), as discussed in Section 16-3.3.2.3.

Additional Supporting Information, as needed

APPENDIX 16-B OUTLINE FOR THE PERIODIC INSPECTION REPORT

This appendix provides the outline for the report on a Periodic Inspection conducted in accordance with 18 CFR § 12.35. As established by 18 CFR § 12.36, any Periodic Inspection Report (PIR) is required to follow this format and provide the appropriate information in each section.

The PIR must include a companion digital reference (e.g., CD or DVD) that contains a searchable version of the PIR in a format that permits high resolution printing and copying of text and graphics. Additional information required on the companion digital reference is discussed in the outline.

Note: In this appendix, the phrase “the previous Part 12D Report” refers to the most recent report on a Periodic Inspection, Comprehensive Assessment, or an inspection performed in accordance with the rules established by FPC Order 315 or FERC Order 122.

PERIODIC INSPECTION REPORT TABLE OF CONTENTS

GENERAL PROVISIONS

Cover Page

The cover page must include, at a minimum:

- Project name and number;
- The name of each Independent Consultant (IC) and, if applicable, the consulting firm each represents;
- The date of the Periodic Inspection Report (PIR).

Table of Contents

Include a table of contents listing each section of the PIR and page numbers. Include separate lists of tables and figures.

Identification of IC Team and Field Inspection Participants

- Identify each member of the Independent Consultant Team and their role.
- List all field inspection participants.
- Refer to the dates of the FERC letters requiring the Part 12D Inspection and approving the Part 12D Inspection Plan and IC Team, which should be included and referenced as Appendix A and Appendix B, respectively.

Certification

- Provide a reference to FERC Order # dated DATE and 18 CFR § 12.36(g)
- Signature(s) and Professional Engineer (PE) stamp(s) of Part 12D Independent Consultant(s).

Note: By signing the PIR, each Part 12D Independent Consultant is stating that the entire report has been developed by them and/or under their direction. The IC shall make a clear statement that the findings, conclusions, recommendations, and evaluations in the report represent their opinion and that, if there are multiple ICs, any disagreement between the ICs is documented accordingly.

SECTION 1: FINDINGS AND RECOMMENDATIONS

1.1 General Conditions and Evaluation of Performance

Summarize the findings of the physical field inspection and evaluation of instrumentation data and surveillance reports. List any project features that were not considered to be in satisfactory condition as well as any potential failure modes (PFMs) that were judged to be active or developing.

Clearly state whether the Independent Consultants (ICs) judge the project to be suitable for continued safe and reliable operation; if not, clearly indicate the reason(s) therefore and reference the corresponding sections of the PIR for details. List any immediate actions that are required to ensure safety, stability, and/or structural integrity of the project.

Summarize any major modifications to project works or standard project operations. State whether any hydrologic or seismic events have occurred that would warrant reevaluation of the associated analyses.

1.2 Potential Failure Modes and Risk

Summarize the findings with respect to potential failure modes. Include a tabular summary of all credible PFMs and for each:

- Clearly state whether any observations or findings indicate the PFM is in progress, developing, neither, or if the initiating loading condition has not occurred; and
- Identify any unusual related conditions observed during the inspection and review of instrumentation data and surveillance reports.

A formal review of previously performed Potential Failure Modes Analysis (PFMA) and risk analysis is not required as part of the PIR. However, the IC must be familiar with the previously identified PFMs for the project in preparation for the site inspection and review and evaluation of the dam safety program. As part of this effort the IC should provide any observations and recommendations related to revisions, additions, or deletions relative to the previously identified and evaluated PFMs and risk analysis results. If the IC has no observations or recommendations relative to the previously identified PFMs or risk analysis results, then state so, otherwise provide a summary.

1.3 Review and Evaluation of Dam and Public Safety Programs

1.3.1 Owner's Dam Safety Program

Summarize the evaluation of the Owner's Dam Safety Program (ODSP). State whether the ODSP is being implemented appropriately with respect to the project under consideration, based on the experiences of the IC Team during the course of conducting the Periodic Inspection (PI). Summarize identified human and organizational factors.

1.3.2 Dam Safety Surveillance and Monitoring Program

Summarize the evaluation of the surveillance and monitoring program. Clearly state whether the surveillance procedures and instrumentation program are sufficient for monitoring the identified PFMs and general health of the project features.

1.3.3 Hazard Potential Classification

Summarize the evaluation of the hazard potential classification and clearly state whether the current classification is appropriate. Identify any significant changes to the population at risk.

1.3.4 Emergency Action Plan

Summarize the evaluation of the Emergency Action Plan (EAP), including the document itself, response provisions, and the licensee's training procedures. Clearly state whether the EAP is adequate or if any enhancements are recommended.

1.3.5 Public Safety Plan

Summarize the evaluation of the Public Safety Plan (PSP) and clearly state whether the current public safety measures are sufficient for restricting public access to hazardous areas.

1.3.6 Operations and Maintenance

Summarize the evaluation of the Operations and Maintenance (O&M) programs. Clearly state whether the O&M programs are sufficient for ensuring safe and reliable operation of the project.

1.4 Recommendations

Provide a tabular summary of all recommendations made elsewhere in the PIR. The full context of and rationale for each recommendation should be provided only in the appropriate section of the PIR. It is recommended that the same table be used in this section as is required in Appendix C (**Summary of Independent Consultant's Recommendations**).

SECTION 2: DESCRIPTION OF PROJECT FEATURES AND OPERATIONS

2.1 Location and Purpose

Provide the hazard potential classification; project location, stream, and nearest community; a general physical description of the project; and reservoir storage capacity. State the authorized project purposes (e.g., run-of-river power generation, water storage, flow augmentation, flood management, etc.) and construction period.

If the project comprises part of a multi-development project system, describe how the project discussed in this PIR fits into the overall operation of the project system.

Provide a project overview photograph or satellite image, annotated to identify all project features. Include drawings of the plan, profile, and typical sections of each project feature in Appendix D (Project Figures).

2.2 Description of Project Features

Provide a comprehensive description of the project features, including relevant dimensions, physical properties, historical context, etc. Generally, this will be the same information provided in Section 2 of the STID, *though it is important that the IC Team review all relevant project information such that they can describe project features in their own words.* The order in which the project features are discussed should be logical; guidance is provided below.

- For a project with a primary water-retaining feature (i.e., a main dam), that feature should be discussed first, followed by its appurtenances (e.g., wing dams, spillways, powerhouses, etc.).
- For a project that has a long dam that comprises multiple types of sections of equal scale (e.g., left and right embankments, non-overflow gravity sections, a water-retaining intake-powerhouse section, and a gated spillway section), it is recommended that project features be discussed from left-to-right or right-to-left, whichever makes the most sense for the project.
- For a project in which the primary feature is a canal or other water conveyance, the order of discussion should begin at the diversion dam/intake/etc. and continue along the canal or water conveyance.
- For a PIR that covers multiple developments, it is recommended to discuss the developments beginning at the development furthest upstream and progressing downstream.

The order in which the features are discussed shall also be consistent with the order of discussion in other sections of the PIR (e.g., Section 4 [**FIELD INSPECTION OBSERVATIONS AND INTERPRETATION OF MONITORING DATA**]).

Additional details are provided below regarding the information to be provided for various types of project features.

Dam(s)

For each dam, dike, and canal, provide the information listed below that is relevant to the particular type of structure:

- Type of dam (e.g., embankment, concrete gravity, arch, buttress, etc.);
- Structural height and hydraulic height;
- Crest elevation, length, width, and surface material (e.g., asphalt pavement, unpaved, etc.);
- Briefly describe any embankment construction method (i.e., rolled fill, semi-hydraulic/hydraulic fill, zoned embankments, homogenous fill, etc.). For zoned fills a general description of the materials comprising each zone should be included;
- Other relevant dimensions as applicable (e.g., monolith width for concrete dams; radius for arch dams; minimum core width and filter widths for embankments; etc.)
- Upstream and downstream slopes (H:V) and describe any slope protection;
- The location, dimensions, and purpose of any galleries;
- Briefly describe the foundation conditions (soil, bedrock, etc.); and
- Describe any key foundation features (e.g., location and depth of grout curtain, location and depth of drainage curtain, location and depth of cutoff wall, etc.).

Spillway(s)

Describe any spillway(s) that are part of the project. For each, describe:

- The type of release facility (e.g., uncontrolled overflow, radial crest gates, etc.) and list the crest elevation;
- The location of the spillway (e.g., center of dam, which abutment, etc.);
- The approach condition and any inlet structures;
- Description of the discharge path (e.g., unlined channel, lined channel, stilling basin, etc.) along with pertinent details and dimensions;
- Details and dimensions of other components as applicable; and
- The discharge capacity (and associated reservoir elevation).

For gated spillways, also include:

- The number and type of gate(s), their dimensions, methods of operation, and sources of power (primary and backup);
- A description of any anchorage (post-tensioned or passive), wheels, trunnions, etc.; and
- A brief description of any major modifications to the gates since original construction.

Outlet Works

Describe any outlet works that are part of the project. For each:

- Describe any intake structure, upstream conduit, gate chamber, downstream conduit, chute, stilling basin, and discharge channel, and provide pertinent details and dimensions (including materials, diameter, length, etc.);
- List key elevations (e.g., intake sill, regulating gates, etc.);
- Describe the route of any conduit or tunnel and whether it passes through an embankment, concrete section, abutment or foundation (and if so, whether it is alluvium or rock), etc.; and
- List the discharge capacity (and associated reservoir elevation).

Water Conveyances

For each water conveyance, including penstocks:

- Identify the purpose of the conveyance and state the total length;
- Provide relevant dimensions (length and height/width/diameter/etc.) and describe the materials for each distinct section, as well as the beginning and ending stations;
- Describe any pressure-relief systems (e.g., surge tanks/towers, pressure-reducing valves, etc.); and
- For elevated conveyances, describe the support and restraint systems.

Powerhouses

For each powerhouse:

- Identify the location of the powerhouse and general operation protocols (e.g., peaking, base load, etc.);

- Describe the number and type of turbines, their rated generation capacity, and discharge capacity;
- List any key elevations, such as the tailwater level that would result in flooding of the powerhouse; and
- State if the powerhouse is required to be operational to pass flood flows. Document any standard operating procedures required to ensure operability.

Other Features

List and describe any other relevant project features and provide a level of detail commensurate with the importance of the feature.

Dam Safety Incidents

Provide a brief summary of previous dam safety incidents (failures, near-failures, misoperations, etc.) and any resulting modifications or remediation.

2.3 Summary of Operations

General Information

Describe who (organization, company, agency, etc.) operates the dam.

Discuss where project operations personnel live (general vicinity, time and distance from the project) and how often the operator visits the project. Describe the routes used for access by project personnel as well as any haul routes that may be used to move equipment or supplies in the event of a dam safety emergency. Briefly describe any procedures used to prepare the project for winter, or to ensure that project works remain operational during periods of cold weather.

Reservoir Operations

Describe the typical reservoir cycle (annual). Include graphical depictions of any reservoir rule curves and minimum storage/flow requirements as applicable. List the maximum water surface elevation to date. List the maximum historic releases and associated dates through the spillway, outlet works, and powerhouse. Describe the safe downstream discharge channel capacity and what damages may occur above that level (if known).

Gate Operations

Describe any standard protocols related to operations of spillway gates and other discharge pathways (e.g., powerhouse, outlet works, etc.). For example, identify:

- Lead and following gates/valves;

- Any preferentially-operated gates/valves and the reasons therefore (e.g., due to erosion or tailwater concerns);
- Gates/valves connected to automatic-operation controls;
- Allowable differentials between adjacent gates;
- Any procedures to safely allow discharge through powerhouse units without load; and
- Other information as needed.

Describe all mechanisms and methods for operating gates, including traveling (shared) hoists, dedicated hoists, and formalized backup procedures (e.g., manual operation, use of an electric drill to drive gears, use of a crane to raise gates, etc.). Include a discussion of primary and back-up power sources for gates and valves, as well as alternative means of operation (i.e., if/how a gate/valve could be operated in the event of a failure of mechanical components of the hoist system). Describe any remote operation capabilities, including the communication facilities that enable such operation. Discuss the availability of personnel, including their training, as it relates to being able to operate gates in the required amount of time.

Attachments

Include the following attachments to this section:

- Reservoir stage-storage-area curve; and
- Discharge rating curves for each spillway and any outlet works.

SECTION 3: PROJECT STATUS

3.1 Modifications to Project Works

Identify any changes or modifications to the project works since the previous Part 12D Report.

3.2 Modifications to Project Operations

Identify any changes or modifications to the standard project operations, which are discussed in Section 2.3 (**Summary of Operations**), since the previous Part 12D Report.

3.3 Recommendations from Previous Part 12D Reports

Include a summary table indicating the status/disposition (e.g., complete, study in progress, etc.) of each recommendation from the preceding Part 12D report, as well as recommendations from previous Part 12D reports that:

- Are incomplete at the time of the current Part 12D report; or
- Were completed after the previous Part 12D report but before the current Part 12D report.

3.4 Outstanding/Ongoing Studies

List any major studies that are outstanding or ongoing at the time of the Periodic Inspection. Include a concise summary of the purpose of each study and its schedule for completion.

3.5 Completed Studies

List any major studies completed since the previous Part 12D Report. Include a concise summary of the findings and conclusions of each study. It is not necessary to duplicate all the information that was documented in the previous section.

3.6 Summary of Operations and Maintenance Programs

List any periodic or ongoing maintenance performed to maintain the project works in safe and reliable operating condition (several examples are listed below). Clearly indicate when each of the maintenance programs was performed.

- Maintenance of mechanical components of spillway gate hoists and valves;
- Lubrication of radial gate trunnions and other bearings (e.g., fixed wheel gates);
- Maintenance of backup power systems;
- Patching and sealing of concrete;
- Application of joint filler in spillway chutes;
- Scour repairs;
- Etc.

3.7 Previously Identified PFMs

Provide a summary list of previously identified PFMs (in tabular form) in accordance with the recommendations for Table 1 provided in Chapter 17 of the Engineering Guidelines. For projects where the PI is performed before a Comprehensive Assessment (CA) has been completed, the previously identified PFM category (I, II, III, or IV) may be used as the PFM disposition. Otherwise, the PFM disposition should be as defined in Chapter 17 of the Engineering Guidelines (ruled-out, excluded, credible, urgent, or insufficient information).

Include a listing of the PFMA team members, including the facilitator(s) and location and dates of the previous PFMA session(s).

Provide recommendations as needed to improve the PFMA (e.g., expanding the descriptions, correcting inaccurate information, identifying new PFMs, etc.). Note that the IC Team for the PIR is **not** expected to actually rewrite the PFMs, only to provide recommendations for improvements based on their findings.

SECTION 4: FIELD INSPECTION OBSERVATIONS AND INTERPRETATION OF MONITORING DATA

The site inspection should be performed in general conformance with the inspection guidelines provided in Bureau of Reclamation, Safety Evaluation of Existing Dams (SEED) Manual. Where the condition of a feature is described, use the following terms (satisfactory, fair, poor, unknown). Qualifying terms such as good, excellent, bad, etc. should be avoided.

4.1 General

The site inspection report shall include the following information:

- Date of inspection.
- Names and affiliations of inspection participants.
- Operating conditions at the time of the inspection, including:
    - Weather conditions on the day of the inspection (note any recent precipitation, which could affect seepage observations);
    - Reservoir and tailrace water surface elevations;
    - Inflows (if known);
    - Releases, including through any spillway(s), outlet works, and powerhouse(s).

For any seismic or hydrologic events that occurred and triggered a special inspection of any project features since the previous Part 12D inspection:

- Identify the date of the event;
- Describe the reason a special inspection was performed (e.g., magnitude of an earthquake, amount of discharge through the spillway, etc.); and
- Ensure that the findings of the inspection are discussed with respect to the relevant project features.

For each project feature, include the subsections listed below. The project features shall be discussed in the same order as listed in Section 2.2 (**Description of Project Features**).

4.2 [Name of Project Feature 1]

4.2.1 Field Inspection Observations

Discuss the observations of the IC Team members during the field inspection. Provide representative photographs with the text or clear references to photographs included in Appendix F (**Inspection Photographs**).

4.2.2 Review and Evaluation of Instrumentation Data and Surveillance

Provide a thorough review and evaluation of any instrumentation data collected to-date. Discuss what constitutes expected behavior of each instrument and identify any trends or unusual data (e.g., outside the expected range or historic range, or indicative of poor instrument maintenance or procedures). Interpret and evaluate the data with respect to performance of the project feature. Include in the body of the report, as needed, annotated snapshots of data along with any statistical evaluation; alternatively, reference that information as provided in Appendix E (**Instrumentation Monitoring Data Plots**).

Provide a summary of the findings of routine or special surveillance performed by the licensee or third-party consultants (e.g., a diver inspection of the upstream face of a concrete gravity dam). This should incorporate a review of licensee inspection checklists, contractor special inspection reports, etc. Evaluate the findings with respect to performance of the project feature.

4.2.3 Evaluation with Respect to Potential Failure Modes

For each identified PFM related to the project feature:

- Provide a clear evaluation of whether the PFM is considered active or developing, based on field observations and the review of instrumentation data and surveillance. If the loading condition did not occur during the report period, state so and limit the evaluation accordingly.
- Document any changed circumstances that could influence the PFM classification (e.g., credible, dismissed, etc.), and briefly evaluate the potential impacts thereof.
- If there are any risk reduction measures in place, evaluate the effectiveness thereof. For any risk reduction measures that were previously recommended but not implemented, provide an evaluation of the stated rationale for not implementing those risk reduction measures.

State whether any field observations, instrumentation data, or surveillance indicates that an unidentified PFM is active or developing. If necessary, recommend a supplemental PFMA.

4.2.4 Conclusion

Provide a conclusion with respect to the condition of each project feature and its suitability for continued operation.

4.3 [Name of Project Feature 2]

4.3.1 Field Inspection Observations

4.3.2 Review and Evaluation of Instrumentation Data and Surveillance

4.3.3 Evaluation with Respect to Potential Failure Modes

4.3.4 Conclusion

4.4 [Name of Project Feature 3] etc.

Include additional sections for project features as needed.

4.*X* Overall Interpretation of Instrumentation Data

(*Note: the numbering for this section will depend on the number of project features discussed.*)

Discuss and evaluate any other instrumentation data that is unrelated to specific project features, and any previously-discussed instrumentation data that may, when considered as a whole and not constrained to a single project feature, may provide insight into the site and project performance (e.g., groundwater profile at site).

Evaluate whether any instrumentation readings at the various project features may indicate site or loading conditions that are inconsistent with the current understanding of the project.

SECTION 5: REVIEW AND EVALUATION OF DAM AND PUBLIC SAFETY PROGRAMS

5.1 Owner's Dam Safety Program

If the project is subject to 18 CFR Part 12, Subpart F:

State that the project is subject to 18 CFR Part 12, Subpart F. Discuss any observations with respect to the implementation of the Owner's Dam Safety Program. The discussion should be based on interactions with licensee staff during preparation, performance, and follow-up related to the Periodic Inspection. Unless specifically requested by the FERC, or proposed by the licensee and accepted by the FERC, the IC is not expected to provide a level of detail and evaluation of the ODSP that constitutes an external audit as required by 18 CFR § 12.65.

Human and organizational factors should be identified and assessed, including organizational culture and decision-making authority.

If the project is not subject to 18 CFR Part 12, Subpart F:

State that the project is not subject to 18 CFR Part 12, Subpart F and explain the reasons therefore.

5.2 Dam Safety Surveillance and Monitoring Program

Summarize the frequency and scope of licensee and third-party surveillance of project features, including the inspection of any typically inaccessible features (e.g., toe drains, submerged conduits, etc.). A tabular format is recommended. At a minimum, the following information should be presented:

- Frequency (e.g., daily, monthly, quinquennial, etc.);
- Type of surveillance (e.g., visual, underwater, drone, etc.);
- Project features observed; and
- Who performs the inspection (e.g., operations staff, dam safety engineer, consultant, etc.).

Evaluate whether the current surveillance procedures are sufficient for monitoring for the development of the identified credible PFMs. Assess the frequency of inspection of all project features, including those inaccessible features that are related to identified credible PFMs. As needed, recommend enhancements to the surveillance program to monitor for the development of credible PFMs, as general health monitoring, and for post-event monitoring (e.g., post-earthquake, post-flood, etc.).

Summarize the instrumentation program and data collection. A tabular format is recommended. At a minimum, the following information should be presented:

- Instrument type and location;
- Frequency of manual and automated readings (if applicable); and
- A description of instrument behavior related to environmental factors (e.g., reservoir level, precipitation, temperature, etc.), if applicable.

Evaluate whether the current instrumentation program is sufficient for the detection of the identified credible PFMs. As needed, recommend additional instrumentation to monitor for the development of credible PFMs, as general health monitoring, and for post-event monitoring (e.g., post-earthquake, post-flood, etc.).

5.3 Hazard Potential Classification

Identify the current hazard potential classification, the date of the dam breach analysis, downstream hazard assessment of record, and provide a concise description of the potential impacts of a hypothetical dam failure.

Document any significant changes in the downstream development and any previously unidentified potential impacts within the inundation zone (e.g., critical transportation infrastructure, schools or hospitals, water treatment facilities, etc.). Identify the nearest non-project structure and its approximate distance and time-to-impact from the dam. Describe how the review was performed (e.g., viewed from dam, aerial or satellite imagery, verbal reports from licensee staff, etc.).

Evaluate whether the current hazard potential classification remains appropriate; whether it should be changed; or whether additional investigations are required to determine the appropriate classification.

5.4 Emergency Action Plan

If the project is subject to 18 CFR Part 12, Subpart C:

Identify the dates of the most recent reprint and annual revision of the EAP.

List any EAP activations and tests (annual drills, tabletop exercises, functional exercises, etc.) conducted since the previous Part 12D Report. Evaluate the findings of those activations and tests and state whether any recommended revisions were implemented appropriately.

Discuss the communication methods, response procedures, and EAP training program. Evaluate the adequacy of each.

If the project has a Sudden Failure Assessment (SFA), evaluate the detection, verification, notification, and Emergency Management Agency (EMA) response times. State the total Excess Response Time (ERT) and evaluate any enhancements the licensee has implemented or is considering, including early warning systems. Document any

interviews with first responders, which are strongly recommended if the ERT is less than fifteen minutes. Provide additional recommendations for enhancements as needed.

If the project is required to complete a radiological response plan under 18 CFR § 12.22(c), discuss and evaluate those provisions.

If the project is not subject to 18 CFR Part 12, Subpart C:

State that the project is not subject to 18 CFR Part 12, Subpart C and explain the reasons therefore. If any conditions were identified such that the IC recommends the project prepare an EAP, thoroughly describe and document the conditions. Otherwise, state that the continued exemption is appropriate.

If the project is required to complete a radiological response plan under 18 CFR § 12.22(c), discuss and evaluate those provisions.

5.5 Public Safety Plan

Identify the date of the current PSP. State whether the signs and devices observed during the field inspection were consistent with those described in the plan. Identify any discrepancies observed.

Document any project-related public safety incidents that have occurred since the previous Part 12D Report. Evaluate the overall effectiveness of the PSP. If needed, recommended improvements to the signage or devices.

5.6 Operations and Maintenance

Evaluate whether any maintenance activities could indicate an active or developing potential failure mode, whether identified or not, and discuss any necessary maintenance that has been deferred and why. Evaluate whether the operations and maintenance programs listed in Section 3.6 (**Summary of Operations and Maintenance Programs**) are considered sufficient for the safe and reliable operation of the project. Recommend any changes as needed related to implementation, training, reporting, etc.

APPENDICES FOR THE PERIODIC INSPECTION REPORT

A FERC Letter Requiring Part 12D Inspection

Include only the letter in the hard copy Periodic Inspection Report. Any enclosures or attachments to the letter shall be included in the digital copy.

B FERC Letter Approving Part 12D Independent Consultant Team

Include only the letter itself in the hard copy Periodic Inspection Report. Any enclosures or attachments to the letter shall be included in the digital copy. If multiple letters were issued (e.g., a conditional approval requesting supplemental information, or an approval of a change in the team members), all shall be included.

C Summary of Independent Consultant's Recommendations

Include a summary table documenting all of the current Independent Consultant's recommendations. This information should be provided in the same order as it is listed in Section 1.4: Recommendations. The table should be formatted such that it can be easily repurposed by the licensee for tracking the status of recommendations in future years.

D Project Figures

Include a set of legible figures sufficient to foster a clear understanding of the project features. The level of detail should be informative but not excessive; FERC exhibit drawings can be used. In a departure from previous guidance, this information must be included in the PIR; binding the STID with the PIR to eliminate duplication is no longer an option.

- A general location map, annotated with the location(s) of project facilities, including water conveyances, access routes, major roads, and towns;
- Plan drawings of project facilities;
- Typical sections, elevations, and profiles of key project features (e.g., dams, spillways, powerhouses, intakes, emergency/fuse plug spillways, chute profiles, etc.);
- Typical sections and profiles of water conveyances;
- A satellite or aerial image of the project and downstream area, annotated as needed; and
- Spillway and tailwater rating curves.

Additional information should be provided as needed.

E Instrumentation Monitoring Data Plots

This appendix shall include any instrumentation monitoring data plots and statistical analysis prepared by the IC Team to evaluate the data and performance of project

features, along with any DSSMR plots considered critical to understanding the IC Team's evaluation.

It is not necessary for the printed copy of the PIR to reproduce every plot that has already been provided in an annual Dam Safety Surveillance and Monitoring Report (DSSMR). However, all DSSMRs reviewed by the IC Team should be included digitally with the PIR.

F Inspection Photographs

The hard copy Periodic Inspection Report must include representative photographs, either in this appendix or in Section 4: **FIELD INSPECTION OBSERVATIONS AND INTERPRETATION OF MONITORING DATA**.

Digital versions of the inspection photographs shall be provided on the companion digital reference and shall be available as individual files at full resolution. A hyperlinked index, naming convention, or other reference system should be established so photographs can be located easily by reviewers.

G Inspection Checklists and/or Field Notes

Include any inspection checklists and/or field notes digitally with the PIR.

H Operation and Maintenance Documentation

Include any operation and maintenance documentation as needed. Some examples of this type of documentation include:

- Spillway gate testing and trunnion lubrication records;
- Backup power maintenance logs;
- Crack sealing;
- Concrete repairs; and

Other information as needed.

APPENDIX 16-C OUTLINE FOR THE PI PRE-INSPECTION PREPARATION REPORT

This appendix provides the outline for the Pre-Inspection Preparation Report on a Periodic Inspection conducted in accordance with 18 CFR § 12.35. Any Periodic Inspection Pre-Inspection Preparation Report (PI-PIPR) is required to follow this format and provide the appropriate information in each section. The requirement to provide a PI-PIPR is established in 18 CFR § 12.40(f)(1).

Several important notes regarding this appendix:

- **This outline generally provides only the section headings.** Unless otherwise indicated, the information required in each section is the same information required in the corresponding section of the Periodic Inspection Report (PIR), an outline of which is available as Chapter 16, Appendix B. The sections have been renumbered in the PI-PIPR though the sequential order is the same.
- Clarification is provided in some cases to limit the expected depth of information provided in the PI-PIPR. However, the more detail that is provided in the PI-PIPR, the better prepared the team will be for the field inspection and preparation of the PIR.
- **Any evaluations and conclusions in the PI-PIPR are considered preliminary.** It is entirely acceptable, and even expected, for the IC Team to acquire new information or a different understanding of the project and its components between completion of the PI-PIPR and the PIR. **The FERC does not intend to compare the PI-PIPR to the PIR to identify changes in evaluations or conclusions.**
- The phrase “the previous Part 12D Report” refers to the most recent report on a Periodic Inspection, Comprehensive Assessment, or an inspection performed in accordance with the rules established by FPC Order 315 or FERC Order 122.

GENERAL PROVISIONS

Cover Page

The cover page must include, at a minimum:

- Project name and number;
- The name of each Independent Consultant and, if applicable, the consulting firm each represents;
- The date of the Periodic Inspection Pre-Inspection Preparation Report (PI-PIPR).

Table of Contents

Include a table of contents listing each section of the PI-PIPR and page numbers. Include separate lists of tables and figures.

Identification of IC Team

- Identify each member of the Independent Consultant Team and their role. Attach resumes for those IC Team members whose resumes were not included with the Part 12D Inspection Plan.

SECTION 1: DESCRIPTION OF PROJECT FEATURES AND OPERATIONS

1.1 Location and Purpose
1.2 Description of Project Features
1.3 Summary of Operations

SECTION 2: PROJECT STATUS

2.1 Modifications to Project Works
2.2 Modifications to Project Operations
2.3 Recommendations from Previous Part 12D Reports
2.4 Outstanding/Ongoing Studies
2.5 Completed Studies
2.6 Summary of Operations and Maintenance Programs

SECTION 3: INTERPRETATION OF MONITORING DATA

3.1 General

For each project feature, include the subsections listed below. The project features shall be discussed in the same order as listed in Section 1.2 (**Description of Project Features**).

3.2 [Name of Project Feature 1]

3.2.1 Review and Evaluation of Instrumentation Data and Surveillance

Provide a thorough review and evaluation of any instrumentation data collected to-date. Discuss what constitutes expected behavior of each instrument and identify any trends or unusual data (e.g., outside the expected range or historic range, or indicative of poor instrument maintenance or procedures). Interpret and evaluate the data with respect to performance of the project feature. Include in the body of the report, as needed, annotated snapshots of data along with any statistical evaluation; alternatively, reference that information as provided in Appendix B (**Instrumentation Monitoring Data Plots**).

Provide a summary of the findings of routine or special surveillance performed by the licensee or third-party consultants (e.g., a diver inspection of the upstream face of a concrete gravity dam). This should incorporate a review of licensee inspection checklists, contractor special inspection reports, etc. Evaluate the findings with respect to performance of the project feature.

3.3 [Name of Project Feature 2]

3.3.1 Review and Evaluation of Instrumentation Data and Surveillance

3.4 [Name of Project Feature 3] etc.

Include additional sections for project features as needed.

SECTION 4: REVIEW AND EVALUATION OF DAM AND PUBLIC SAFETY PROGRAMS

4.1 Owner's Dam Safety Program

4.2 Dam Safety Surveillance and Monitoring Program

4.3 Hazard Potential Classification

4.4 Emergency Action Plan

4.5 Public Safety Plan

4.6 Operations and Maintenance

APPENDICES FOR THE PI PRE-INSPECTION PREPARATION REPORT

A Project Figures

Include a set of figures sufficient to foster a clear understanding of the project features. The level of detail should be informative but not excessive; FERC exhibit drawings can be used.

- A general location map, annotated with the location(s) of project facilities, including water conveyances, access routes, major roads, and towns;
- Plan drawings of project facilities;
- Typical sections, elevations, and profiles of key project features (e.g., dams, spillways, powerhouses, intakes, emergency/fuse plug spillways, chute profiles, etc.);
- Typical sections and profiles of water conveyances;
- A satellite or aerial image of the project and downstream area, annotated as needed; and
- Spillway and tailwater rating curves.

Additional information should be provided as needed.

B Instrumentation Monitoring Data Plots

This appendix shall include any instrumentation monitoring data plots and statistical analysis prepared by the IC Team to evaluate the data and performance of project features, along with any DSSMR plots considered critical to understanding the IC Team's evaluation.

It is not necessary for the printed copy of the PI-PIPR to reproduce every plot that has already been provided in an annual Dam Safety Surveillance and Monitoring Report (DSSMR). However, all DSSMRs reviewed by the IC Team should be included digitally with the PI-PIPR.

APPENDIX 16-D OUTLINE FOR THE COMPREHENSIVE ASSESSMENT REPORT

This appendix provides the outline for the report on a Comprehensive Assessment conducted in accordance with 18 CFR § 12.37. As established by 18 CFR § 12.38, any Comprehensive Assessment Report (CAR) is required to follow this format and provide the appropriate information in each section.

The CAR must include a companion digital reference (e.g., CD or DVD) that contains a searchable version of the CAR in a format that permits high resolution printing and copying of text and graphics. Additional information required on the companion digital reference is discussed in the outline.

Note: In this appendix, the phrase "the previous Part 12D Report" refers to the most recent report on a Periodic Inspection, Comprehensive Assessment, or an inspection performed in accordance with the rules established by FPC Order 315 or FERC Order 122.

COMPREHENSIVE ASSESSMENT REPORT TABLE OF CONTENTS

GENERAL PROVISIONS

Cover Page

The cover page must include, at a minimum:

- Project name and number;
- The name of each Independent Consultant (IC) and, if applicable, the consulting firm each represents;
- The date of the Comprehensive Assessment Report (CAR).

Table of Contents

Include a table of contents listing each section of the CAR and page numbers. Include separate lists of tables and figures.

Identification of IC Team and Field Inspection Participants

- Identify each member of the Independent Consultant Team and their role.
- List all field inspection participants.
- Refer to the dates of the FERC letters requiring the Part 12D Inspection and approving the Part 12D Inspection Plan and IC Team, which should be included and referenced as Appendix A and Appendix B, respectively.

Certification

- Provide a reference to FERC Order # dated DATE and 18 CFR § 12.38(h)
- Signature(s) and Professional Engineer (PE) stamp(s) of Part 12D Independent Consultant(s).

Note: By signing the CAR, each Part 12D Independent Consultant is stating that the entire report has been developed by them and/or under their direction. The IC shall make a clear statement that the findings, conclusions, recommendations, and evaluations in the report represent their opinion and that, if there are multiple ICs, any disagreement between the ICs is documented accordingly.

SECTION 1: FINDINGS AND RECOMMENDATIONS

1.1 General Conditions and Evaluation of Performance

Summarize the findings of the physical field inspection and evaluation of instrumentation data and surveillance reports. List any project features that were not considered to be in satisfactory condition as well as any potential failure modes (PFMs) that were judged to be active or developing.

Clearly state whether the Independent Consultants (ICs) judge the project to be suitable for continued safe and reliable operation; if not, clearly indicate the reason(s) therefore and reference the corresponding sections of the CAR for details. List any immediate actions that are required to ensure safety, stability, and/or structural integrity of the project.

Summarize any major modifications to project works or standard project operations. State whether any hydrologic or seismic events have occurred that would warrant reevaluation of the associated analyses.

1.2 Potential Failure Modes and Risk

Summarize the findings with respect to potential failure modes. Include a tabular summary of all credible PFMs and for each:

- Clearly state whether any observations or findings indicate the PFM is in progress, developing, neither, or if the initiating loading condition has not occurred; and
- Identify any unusual related conditions observed during the inspection and review of instrumentation data and surveillance reports.

Summarize the risk associated with each credible PFM (in the same table summarizing the PFMs) and include a copy of the risk matrix. For each risk-driver PFM evaluated, describe the failure likelihood and key evidence supporting the assessment. Describe the primary consequence center(s) including proximity to the dam, population at risk, and life loss potential.

Provide the downstream non-damaging discharge and estimated maximum release. Describe the impacts of planned spillway releases on the primary consequence center(s). Provide a brief summary of any risk reduction measures that are recommended for immediate implementation. Provide a listing of the significant items identified from the major findings and understandings from the risk analysis.

1.3 Review and Evaluation of Design and Construction

Summarize the findings of the review and evaluation of design and construction. List any significant findings that may warrant reevaluation of prior conclusions with respect to project safety.

1.4 Review and Evaluation of Previous Analyses

Summarize the findings of the review and evaluation of previous analyses. List any previous analyses that were determined to be inaccurate, irrelevant, or inconsistent with the current state-of-the-practice to a degree that does or may warrant reevaluation of prior conclusions with respect to project safety.

1.5 Review and Evaluation of Dam and Public Safety Programs

1.5.1 Owner's Dam Safety Program

Summarize the evaluation of the Owner's Dam Safety Program (ODSP). State whether the ODSP is being implemented appropriately with respect to the project under consideration, based on the experiences of the IC Team during the course of conducting the Comprehensive Assessment (CA). Summarize identified human and organizational factors.

1.5.2 Dam Safety Surveillance and Monitoring Program

Summarize the evaluation of the surveillance and monitoring program. Clearly state whether the surveillance procedures and instrumentation program are sufficient for monitoring the identified PFMs and general health of the project features.

1.5.3 Hazard Potential Classification

Summarize the evaluation of the hazard potential classification and clearly state whether the current classification is appropriate. Identify any significant changes to the population at risk.

1.5.4 Emergency Action Plan

Summarize the evaluation of the Emergency Action Plan (EAP), including the document itself, response provisions, and the licensee's training procedures. Clearly state whether the EAP is adequate or if any enhancements are recommended.

1.5.5 Public Safety Plan

Summarize the evaluation of the Public Safety Plan (PSP) and clearly state whether the current public safety measures are sufficient for restricting public access to hazardous areas.

1.5.6 Operations and Maintenance

Summarize the evaluation of the Operations and Maintenance (O&M) programs. Clearly state whether the O&M programs are sufficient for ensuring safe and reliable operation of the project.

1.5.7 Spillway Adequacy

Summarize the findings with respect to spillway adequacy. List any critical issues identified with respect to the potential for misoperation, failure to operate, blockage, and debilitating damage. Describe and evaluate the expected performance of any spillways

during the computed discharge capacity. Clearly state whether the spillway capacity is adequate for ensuring project safety.

1.5.8 Supporting Technical Information Document

Summarize the findings of the review and evaluation of the Supporting Technical Information Document (STID). Provide a concise description of the overall extent of updates required to ensure the STID meets the requirements of Chapter 15 of the Guidelines. Identify any key information that was found to be factually incorrect or sufficiently misleading that it does or may require reassessment of previous conclusions.

1.6 Recommendations

Provide a tabular summary of all recommendations made elsewhere in the CAR. The full context of and rationale for each recommendation should be provided only in the appropriate section of the CAR. It is recommended that the same table be used in this section as is required in Appendix C (**Summary of Independent Consultant's Recommendations**).

SECTION 2: DESCRIPTION OF PROJECT FEATURES AND OPERATIONS

2.1 Location and Purpose

Provide the hazard potential classification; project location, stream, and nearest community; a general physical description of the project; and reservoir storage capacity. State the authorized project purposes (e.g., run-of-river power generation, water storage, flow augmentation, flood management, etc.) and construction period.

If the project comprises part of a multi-development project system, describe how the project discussed in this CAR fits into the overall operation of the project system.

Provide a project overview photograph or satellite image, annotated to identify all project features. Include drawings of the plan, profile, and typical sections of each project feature in Appendix D (**Project Figures**).

2.2 Description of Project Features

Provide a comprehensive description of the project features, including relevant dimensions, physical properties, historical context, etc. Generally, this will be the same information provided in Section 2 of the STID, *though it is important that the IC Team review all relevant project information such that they can describe project features in their own words.* The order in which the project features are discussed should be logical; guidance is provided below.

- For a project with a primary water-retaining feature (i.e., a main dam), that feature should be discussed first, followed by its appurtenances (e.g., wing dams, spillways, powerhouses, etc.).
- For a project that has a long dam that comprises multiple types of sections of equal scale (e.g., left and right embankments, non-overflow gravity sections, a water-retaining intake-powerhouse section, and a gated spillway section), it is recommended that project features be discussed from left-to-right or right-to-left, whichever makes the most sense for the project.
- For a project in which the primary feature is a canal or other water conveyance, the order of discussion should begin at the diversion dam/intake/etc. and continue along the canal or water conveyance.
- For a CAR that covers multiple developments, it is recommended to discuss the developments beginning at the development furthest upstream and progressing downstream.

The order in which the features are discussed shall also be consistent with the order of discussion in other sections of the CAR (e.g., Section 4.4 [**Analyses of Project Features**]

and Section 6 [**FIELD INSPECTION OBSERVATIONS AND INTERPRETATION OF MONITORING DATA**]).

Additional details are provided below regarding the information to be provided for various types of project features.

Dam(s)

For each dam, dike, and canal, provide the information listed below that is relevant to the particular type of structure:

- Type of dam (e.g., embankment, concrete gravity, arch, buttress, etc.);
- Structural height and hydraulic height;
- Crest elevation, length, width, and surface material (e.g., asphalt pavement, unpaved, etc.);
- Briefly describe any embankment construction method (i.e., rolled fill, semi-hydraulic/hydraulic fill, zoned embankments, homogenous fill, etc.). For zoned fills a general description of the materials comprising each zone should be included;
- Other relevant dimensions as applicable (e.g., monolith width for concrete dams; radius for arch dams; minimum core width and filter widths for embankments; etc.)
- Upstream and downstream slopes (H:V) and describe any slope protection;
- The location, dimensions, and purpose of any galleries;
- Briefly describe the foundation conditions (soil, bedrock, etc.); and
- Describe any key foundation features (e.g., location and depth of grout curtain, location and depth of drainage curtain, location and depth of cutoff wall, etc.).

Spillway(s)

Describe any spillway(s) that are part of the project. For each, describe:

- The type of release facility (e.g., uncontrolled overflow, radial crest gates, etc.) and list the crest elevation;
- The location of the spillway (e.g., center of dam, which abutment, etc.);
- The approach condition and any inlet structures;
- Description of the discharge path (e.g., unlined channel, lined channel, stilling basin, etc.) along with pertinent details and dimensions;

- Details and dimensions of other components as applicable; and
- The discharge capacity (and associated reservoir elevation).

For gated spillways, also include:

- The number and type of gate(s), their dimensions, methods of operation, and sources of power (primary and backup);
- A description of any anchorage (post-tensioned or passive), wheels, trunnions, etc.; and
- A brief description of any major modifications to the gates since original construction.

Outlet Works

Describe any outlet works that are part of the project. For each:

- Describe any intake structure, upstream conduit, gate chamber, downstream conduit, chute, stilling basin, and discharge channel, and provide pertinent details and dimensions (including materials, diameter, length, etc.);
- List key elevations (e.g., intake sill, regulating gates, etc.);
- Describe the route of any conduit or tunnel and whether it passes through an embankment, concrete section, abutment or foundation (and if so, whether it is alluvium or rock), etc.; and
- List the discharge capacity (and associated reservoir elevation).

Water Conveyances

For each water conveyance, including penstocks:

- Identify the purpose of the conveyance and state the total length;
- Provide relevant dimensions (length and height/width/diameter/etc.) and describe the materials for each distinct section, as well as the beginning and ending stations;
- Describe any pressure-relief systems (e.g., surge tanks/towers, pressure-reducing valves, etc.); and
- For elevated conveyances, describe the support and restraint systems.

Powerhouses

For each powerhouse:

- Identify the location of the powerhouse and general operation protocols (e.g., peaking, base load, etc.);
- Describe the number and type of turbines, their rated generation capacity, and discharge capacity;
- List any key elevations, such as the tailwater level that would result in flooding of the powerhouse; and
- State if the powerhouse is required to be operational to pass flood flows. Document any standard operating procedures required to ensure operability and ensure those procedures are reviewed and evaluated in Section 8.8.4 (**Standard Operating Procedures**).

Other Features

List and describe any other relevant project features and provide a level of detail commensurate with the importance of the feature.

Dam Safety Incidents

Provide a brief summary of previous dam safety incidents (failures, near-failures, misoperations, etc.) and any resulting modifications or remediation.

2.3 Summary of Operations

General Information

Describe who (organization, company, agency, etc.) operates the dam.

Discuss where project operations personnel live (general vicinity, time and distance from the project) and how often the operator visits the project. Describe the routes used for access by project personnel as well as any haul routes that may be used to move equipment or supplies in the event of a dam safety emergency. Briefly describe any procedures used to prepare the project for winter, or to ensure that project works remain operational during periods of cold weather.

Reservoir Operations

Describe the typical reservoir cycle (annual). Include graphical depictions of any reservoir rule curves and minimum storage/flow requirements as applicable. List the maximum water surface elevation to date. List the maximum historic releases and associated dates through the spillway, outlet works, and powerhouse. Describe the safe downstream discharge channel capacity and what damages may occur above that level (if known).

Gate Operations

Describe any standard protocols related to operations of spillway gates and other discharge pathways (e.g., powerhouse, outlet works, etc.). For example, identify:

- Lead and following gates/valves;
- Any preferentially-operated gates/valves and the reasons therefore (e.g., due to erosion or tailwater concerns);
- Gates/valves connected to automatic-operation controls;
- Allowable differentials between adjacent gates;
- Any procedures to safely allow discharge through powerhouse units without load; and
- Other information as needed.

Describe all mechanisms and methods for operating gates, including traveling (shared) hoists, dedicated hoists, and formalized backup procedures (e.g., manual operation, use of an electric drill to drive gears, use of a crane to raise gates, etc.). Include a discussion of primary and back-up power sources for gates and valves, as well as alternative means of operation (i.e., if/how a gate/valve could be operated in the event of a failure of mechanical components of the hoist system). Describe any remote operation capabilities, including the communication facilities that enable such operation. Discuss the availability of personnel, including their training, as it relates to being able to operate gates in the required amount of time.

Attachments

Include the following attachments to this section:

- Reservoir stage-storage-area curve; and
- Discharge rating curves for each spillway and any outlet works.

SECTION 3: REVIEW AND EVALUATION OF DESIGN BASIS AND CONSTRUCTION

General section guidance: The intent of this section is to provide a general overview of the design basis and construction of the project features. It is not intended to duplicate or repeat information currently available in the STID. **Do not just repeat the information summarized in the STID.** The IC Team must perform an independent review and evaluation of the associated project records and document their understanding and assessment of the design basis and construction.

As part of this effort, the IC Team must evaluate the records reviewed for completeness; evaluate whether the drawings reflect "as-built" conditions with any significant deviations or modifications identified; evaluate whether standard operating procedures (SOPs) are current and consistent with the design intent; and discuss whether all other relevant documents have been identified and located.

Any drawings of significance to the evaluation and performance of the project, and referenced in this section, should be included in Appendix D. Examples include:

- Geologic plan, profile, and section drawings of dam and key appurtenant structures;
- Drawings of summary logs of foundation explorations for the dam and key appurtenant structures (i.e., key drawings and not every drawing showing every single log);
- Drawings of filter and/or drainage blankets and foundation treatments, including grout curtains and fault treatments;
- Toe drain/foundation drain plan typical section;
- Spillway/outlet drainage features; and
- Other important sections and details.

Specific figures, plots, and other critical supporting information should be included in the text or placed at the back of the section. Examples of information to be included behind this section include:

- Copies of critical or key construction photographs (only if they show features, construction methods, etc. that have significance to discussion in this section of the CAR).
- As-built summaries, plots, and charts of construction materials (e.g., gradation plots of embankment and foundation materials, compressive strength testing of concrete materials, etc.).

Each section below should not only be a general discussion of the design and construction of the feature, but should also include an assessment of those practices to the current state-of-the-practice; for any that may be considered deficient, discuss and evaluate the potential implications with respect to performance of the project. If needed, recommend investigations or remediation as appropriate.

For each section, as appropriate, the IC Team should consider and answer the following questions posed by the Oroville Independent Forensics Team (IFT):

- Is the feature consistent with current design and construction practice?
- If there are variations from current practice, do they compromise the structure and present a risk of failure or unsatisfactory performance?
- If there is not enough information available to make those judgments, is the potential risk sufficient to justify further study or evaluation?

3.1 Engineering Geology

3.1.1 Regional Geology

Provide a brief, general overview of the regional geology and geologic setting, highlighting any geologic features that may be particularly relevant to the design or performance of the dam and other project works.

3.1.2 Site Geology

Describe the site geology, providing discussions of the thicknesses and lateral extent (and continuity) of various foundation units, including overburden. Provide a general description of all of the units present at the project and within the reservoir, with a focus on those features that have engineering significance to the project structures. This includes offering insight into key rock and soil properties such as compressibility, strength, permeability, and liquefaction potential (soils). Include applicable geologic drawings (plan, profile, cross sections) to illustrate foundation conditions.

Include a discussion of available information on the strike and dip of various units, as well as any information on discontinuities (orientation, infilling present, aperture, roughness, etc.) present in the foundation of the dam or appurtenant structures.

3.1.3 Foundation Explorations

Summarize the past exploration programs, providing dates and types of explorations, purpose of programs, and tests conducted. Reference sources of additional information on these past programs. Include a summary drawing, if already available, of the location of explorations.

3.1.4 Geologic Hazards

Summarize information on any landslides in the foundation or reservoir area. Report key thicknesses and volumes of landslides, as well as the general classification of the slide. Summarize any past studies of slide areas, and the findings and conclusions.

Discuss any other geologic hazards in the vicinity of the dam, including but not limited to volcanoes, lahars and mudflows, fault offsets, etc. Summarize any key information on the size or activity of such features, and report findings and conclusions of past studies on these types of hazards.

3.2 Dam

This subsection deals with the details of the design and construction of the primary water-retaining feature (typically, the dam). The following headings are strongly encouraged, although it is recognized that certain facilities may have features that require additional (and in rare cases, fewer) heading topics.

3.2.1 Design Considerations

This subsection discusses the key features of the design, including both strengths and vulnerabilities. Topics worthy of discussion include:

- Designer and the timeframe of the design
- Prime influences on the design (e.g., materials availability, abutment geometry, seepage concerns, etc.)
- General description of design features, referencing key drawings that are to be included at the back of this section
- Discussion of any unique features of the design
- Assessment of how the design compares to current state of practice

3.2.2 Foundation Excavation and Treatment

This subsection details the pertinent aspects of foundation excavation and foundation treatment measures (for the dam and appurtenant structures). Topics to address may include:

- Methods of excavation
- Observations of excavated foundation surfaces
- Any test results or material properties of foundation
- Dewatering difficulties or observations

- Foundation treatment measures such as foundation filters, slush grouting, dental concrete, and blanket and curtain grouting. Include the grout takes in various portions of the foundation.
- Foundation drains (installation, performance, maintenance)
- Discussion of any past performance issues with foundation (seepage, settlements, slumps, etc.)

3.2.3 Materials and Placement

This subsection describes the properties of the materials used to construct the dam. For concrete dams, include a discussion of available information on concrete strengths, reinforcement details, aggregate sources, any concerns with deterioration, and other issues.

For embankment dams, include a listing of the various zones (conveniently done as numbered subheadings). To the extent practicable, provide the following information:

- Borrow source (means of excavation is also relevant with respect to uniformity)
- General gradation (and include average curves if available)
- Key material properties such as plasticity index, compaction density, and moisture content
- Placement and compaction procedures.

3.2.4 Construction Details

Key construction details should be discussed in this subsection. Summarize and evaluate construction methods, sequences, problems, and design changes associated with construction. Possible topics include:

- General description of construction operations or methods, particularly if unusual.
- Use of staged contracts, long work stoppages, or similar unusual schedules.
- Inspection, testing, or instrumentation observations that appear relevant or unusual.
- Observations of foundation surfaces or materials used in construction. Include construction photographs if useful in portraying conditions in dam or foundation.

3.2.5 Modifications

For each major modification completed since original construction, provide a subheading and narrative discussion that addresses the relevant items from each modification, including:

- Brief description of purpose of modification, the project features that were modified, and the year of the modification.
- General description of construction operations or methods, particularly if unusual.
- Inspection, testing, or instrumentation observations that appear relevant or unusual.
- Observations of foundation surfaces or materials used in construction. Include construction photographs if useful in portraying conditions in dam or foundation.

3.3 Spillway

If the facility has a spillway, report any key information on the design, construction, and past performance in this subsection. Topics to address may include:

- Design capacity, and basis for original design
- Any unusual aspects of design
- Any limitations on capacity (structural, social, etc.)
- Previous model studies, if any
- Presence or lack of filters if spillway structure penetrates an embankment
- Construction details, particularly any foundation observations or unusual conditions

3.4 Outlets

If the facility has an outlet works, report any key information on the design, construction, and past performance in this subsection. Topics to address may include:

- Design capacity, and basis for original design
- Any unusual aspects of design
- Any limitations on capacity (structural, social, etc.)
- Previous model studies, if any
- Presence or lack of filters if outlet works conduit penetrates an embankment
- Construction details, particularly any foundation observations or unusual conditions

3.5 Powerplant

If the facility contains any power structures or other structures that either comprise an integral component of the dam or could lead to a dam safety issue, include a discussion of that structure in this subsection. Topics to address may include:

- Design capacity, and basis for original design
- Any unusual aspects of design
- Any limitations on capacity (structural, social, etc.)
- Previous model studies, if applicable
- Construction details, particularly any foundation observations or unusual conditions

3.6 Other Structures

For any other structure that either comprises an integral component of the dam or could lead to a dam safety issue, include a discussion of that structure in this subsection. Topics to address may include:

- Design capacity, and basis for original design
- Any unusual aspects of design
- Any limitations on capacity (structural, social, etc.)
- Previous model studies, if applicable
- Construction details, particularly any foundation observations or unusual conditions

3.7 Mechanical

3.7.1 Spillway

If the facility has mechanical components related to the spillway structure(s), include a discussion of the design and construction of the mechanical features in this subsection. Topics to address include:

- Design capacity, and basis for original design
- Any unusual aspects of design
- Any limitations on capacity
- Previous model studies, if applicable
- Construction details, particularly any unusual conditions

3.7.2 Outlets

If the facility has mechanical components related to the outlet structure(s), include a discussion of the design and construction of the mechanical features in this subsection. Topics to address include:

- Design capacity, and basis for original design

- Any unusual aspects of design
- Any limitations on capacity
- Previous model studies, if applicable
- Construction details, particularly any unusual conditions

3.7.3 Powerhouse

If the facility has mechanical components related to the powerhouse structure(s), include a discussion of the design and construction of the mechanical features in this subsection. Topics to address include:

- Design capacity, and basis for original design
- Any unusual aspects of design
- Any limitations on capacity
- Previous model studies, if applicable
- Construction details, particularly any unusual conditions

SECTION 4: REVIEW AND EVALUATION OF PREVIOUS ANALYSES

Per 18 CFR § 12.38(c), each section listed below must include a clear evaluation of the analyses of record that considers:

- Assumptions, methods, calculations, results, and conclusions of the analysis, including the accuracy thereof;
- Relevance with respect to any associated PFM for which the evaluation thereof is informed by the analysis; and
- Consistency with the current state-of-the-practice.

In each section, identify the analysis of record and document the review thereof; provide a clear conclusion. While many section headings correspond to those in the STID, **do not conflate the review of the analyses with the review of the STID itself**, which is documented in Section 8.8 (Supporting Technical Information Document).

The level of detail provided in this section of the CAR must demonstrate that a thorough review was performed. Invalid assumptions, methodologies, or calculation errors that may significantly affect the results and/or conclusions of the analysis must be clearly identified and documented. The CAR must also contain a comparison between the analysis and the current state-of-the-practice; with discrepancies identified and the potential implications discussed.

Include independent calculations and analysis as needed to justify the evaluation. Independent calculations performed as part of the CAR (flood routings, filter analyses, stability analyses, etc.) should be referenced in the appropriate section and included in their entirety in Appendix K (**Independent Calculations**).

Recommendations for additional studies, investigations, or remediation shall be provided, as needed.

Further guidance is provided below for several categories of analyses. The CAR shall contain additional sections as needed to discuss other relevant studies, as required by 18 CFR § 12.37(a)(2)(iv).

4.1 Geology

Evaluate whether the existing geologic information has been adequately identified, appropriately interpreted and correctly applied. Discuss any identified potential weaknesses in the foundation and abutments (e.g., adversely-oriented joints, weak seams, soluble materials, etc.) and evaluate their potential impacts to the project.

Discuss the methods to determine material properties from previous investigations. Include a comparison of those methods to the current state-of-the-practice. Identify any gaps in the available geologic information and understanding of the site.

4.2 Seismicity

Document the review of project seismicity. List the most recent available peak ground acceleration (PGA) and spectrum for each of the following, as applicable, highlighting the period range of interest for project structures:

- Maximum Credible Earthquake (MCE);
- United States Geological Survey (USGS) 1:2,475 year event; and
- Any probabilistic seismic hazard assessments.

State whether any seismic events have occurred since the previous Part 12D Report that would warrant reevaluation of the analysis that established the current seismic design criteria and any stress and stability analyses based thereon.

Note any other reasons why the seismic loading may have increased or decreased since the previous Comprehensive Assessment, and whether the previous analyses are based on methodologies that are no longer current. Evaluate whether a new seismic hazard analysis is required. Make any recommendations as appropriate.

4.3 Hydrology and Project Hydraulics

Summarize the previous hydrologic and hydraulic analyses in this section.

4.3.1 Precipitation and Snowmelt

State the PMP study of record (e.g., Hydrometeorological report, state study, or site-specific study) and describe key aspects of the methodology; evaluate whether the information and results are still valid for the project. Discuss how the storm was distributed over the watershed and what storm hyetograph was used. Indicate if snowpack and snowmelt were included in the model and, if so, which snowmelt methodology was used.

List the following information as applicable:

- 1-, 6-, 24-, and 72-hour PMP depths for general storms;
- 1- and 6-hour PMP depths for local storms.

4.3.2 Flood Loading and Routings

List the current Flood of Record, Inflow Design Flood (IDF), and Probable Maximum Flood (PMF) inflow and outflow values (as applicable). List the following information as applicable:

- Spillway capacity at the normal maximum water surface elevation
- Zero freeboard spillway capacity
- Peak spillway discharge since the previous Part 12D Report

- Peak reservoir elevation(s) during the previous five years.

Also discuss the following as applicable:

- Past flood loadings, both in terms of Probable Maximum Flood or probabilistic floods;
- If flood loadings have increased or decreased since the previous flood study, explain why;
- Report results of previous flood routings, including amount of resulting freeboard for all structures at a project, or the depth and duration of any overtopping at all structures; and
- Identify any deficiencies with the past flood routings.

State whether any events have occurred since the previous Part 12D Report that would warrant reevaluation of the analysis that established the current IDF/PMF and any hydraulic, scour, and/or overtopping analyses based thereon.

Note any other reasons why the hydrologic loading may have increased or decreased since the previous Comprehensive Assessment, and whether the previous analyses are based on data or methodologies that are no longer current. Evaluate whether a new hydrologic hazard analysis is required. Make any recommendations as appropriate.

4.3.3 Dam Breach Studies

Evaluate the assumptions made in the dam breach analyses, including which project features have been evaluated (e.g., main dam, auxiliary dam, spillway gate, etc.). Evaluate whether the model results are accurate and representative of the expected inundation extent. Identify the modeling software used and whether the model is still valid and appropriate for the project. Recommend additional dam breach analyses as needed.

4.4 Analyses of Project Features

This section shall document the review and evaluation of the analyses of project features, in the same order as they are listed in Section 2.2 (**Description of Project Features**). For each project feature, include a set of numbered headings (e.g., 4.4.X.Y) that contains the subsections discussing the various types of analyses relevant to that type of project feature (e.g., gravity sections, embankment sections, arch dams, spillways, etc.).

Where applicable, the results must be stated in terms of factors of safety and compared to the relevant FERC criteria or guideline. Any deficiencies in the analyses must be identified and the potential implications discussed, with recommendations for further investigation, if needed.

4.4.*X* Analyses of [Project Feature X]

4.4.*X*.1 Static Analyses of [Project Feature X]

Document the review and evaluation of analyses under static loading conditions (including normal, hydrologic, and other special cases as needed). Provide clear delineation of the discussion as it relates to normal and hydrologic loading conditions; while these two loading conditions are similar in that they represent static conditions, the magnitude of loading and response of the structure(s) may be very different.

Stress and Stability

This section shall document the review and evaluation of analyses related to the stress and stability of project features, and is applicable to all dam types; canals; spillways; penstocks, conduits, and other water conveyances; gates and valves; and other appurtenances, as well as powerhouses (whether water-retaining or not).

Foundation Stability

This section shall document the review and evaluation of any analyses related to the stability of the foundation or abutments under static loading conditions.

Seepage and Internal Erosion

This section shall document the review and evaluation of any analyses related to static seepage, and internal erosion (piping) potential, and is applicable to embankment dams and certain types of foundations and abutments.

- Static seepage (gradients, quantity, and quality); and
- Internal erosion, including between and within embankment, foundation, and abutment materials. Available gradations of adjacent embankment and foundation materials should be plotted, and filter compatibility evaluated based on current criteria. If filter criteria are not satisfied, apply University of New South Wales excessive and/or continuing erosion criteria to check the potential for filtering after some erosion occurs. Additional issues to evaluate and discuss may include:
  - Are any of the materials internally unstable?
  - Are there upstream zones that may serve as crack stoppers?
  - Do the downstream zones (or filters) contain excessive or plastic fines, or cementitious materials, that may impact their ability to collapse (and instead be able to sustain a crack)?

Settlement/Deformation

This section shall document the review and evaluation of analyses related to the settlement, consolidation, or deformation of embankment (soil or rock) or foundation (soil or rock) materials under static loading conditions.

4.4.*X*.2 Seismic Analyses of [Project Feature X]

This section shall be provided for all structures regardless of whether seismic analyses have been performed.

If any seismic analyses have been performed, the relevant information shall be documented in the appropriate subsection (listed below).

If seismic analyses have not been performed, the IC Team shall document in this section the rationale for recommending or not recommending the completion of such analyses.

Seismic Loading

State the source(s) of information for seismic loads applied to the project feature. Include any relevant figures that show the time history, response spectrum, etc.

Dynamic Stress and Stability Analyses

This subsection applies to concrete dams and may include the structure and its foundation.

If any dynamic analyses have been performed, discuss:

- The general methodology;
- Development of any numerical models, including input parameters such as material properties, boundary conditions, etc.;
- Evaluation criteria; and
- Interpretation of model output and results.

Liquefaction Analyses

This subsection applies to embankment dams (including the structure and its foundation) as well as any project that includes another type of dam (e.g., concrete gravity dam) constructed atop a soil foundation.

Identify whether or not embankment and/or foundation liquefaction has been evaluated in previous studies. Include the date of the analysis and the method of analysis (qualitative based on material observations; quantitative through the use of SPT, CPT, BPT, or shear wave velocity; or other methods). Evaluate the analysis methodology, input parameters,

analysis assumptions, findings and conclusions. Note any deficiencies in the past analyses or evaluations.

Post-Liquefaction Stability

This subsection applies to embankment dams as well as any project that includes another type of dam (e.g., concrete gravity dam) constructed atop a soil foundation.

If performed, describe dates and methods used in past analyses of post-liquefaction stability. Evaluate and document results (methodology, inputs, assumptions, factors of safety, and conclusions). Note any deficiencies in the past analyses.

Deformation Analyses

This subsection applies to embankment dams.

Dynamic deformations may have been analyzed in previous analyses, whether by simple methods or possibly sophisticated finite element methods. Conditions or assumptions of liquefaction or no liquefaction may have been assumed. Evaluate and summarize the specific details, assumptions, methods, and dates of any past deformation analyses. Review and evaluate the findings and conclusions. Note any deficiencies in the past analyses.

4.4.*X*.3 Hydraulic and Overtopping Analyses of [Project Feature X]

Hydraulic Analyses

This section will generally apply to spillway chutes, though there may be other structures for which hydraulic analyses have been performed.

This section shall document the review and evaluation of any analyses related to stagnation pressure, cavitation, training wall overtopping, etc. related to spillway chutes.

Overtopping and Erosion Analyses

This section shall document the review and evaluation of any analyses related to erosion of embankments, abutments, or the foundation; including erosion caused by overtopping or by expected project releases during normal and flood conditions.

Transient Analyses

This section shall document the review and evaluation of any transient pressure analyses for penstocks, tunnels, and other water conveyances.

4.4.*X*.4 Other Analyses of [Project Feature X]

This section shall document the review and evaluation of any other analyses.

SECTION 5: PROJECT STATUS

5.1 Modifications to Project Works

Identify any changes or modifications to the project works since the previous Part 12D Report.

5.2 Modifications to Project Operations

Identify any changes or modifications to the standard project operations, which are discussed in Section 2.3 (**Summary of Operations**), since the previous Part 12D Report.

5.3 Recommendations from Previous Part 12D Reports

Include a summary table indicating the status/disposition (e.g., complete, study in progress, etc.) of each recommendation from the preceding Part 12D report, as well as recommendations from previous Part 12D reports that:

- Are incomplete at the time of the current Part 12D report; or
- Were completed after the previous Part 12D report but before the current Part 12D report.

5.4 Outstanding/Ongoing Studies

List any major studies that are outstanding or ongoing at the time of the Comprehensive Assessment. Include a concise summary of the purpose of each study and its schedule for completion.

5.5 Completed Studies

List any major studies completed since the previous Part 12D Report. Include a concise summary of the findings and conclusions of each study. It is not necessary to duplicate all the information that was documented in the previous section.

5.6 Summary of Operations and Maintenance Programs

List any periodic or ongoing maintenance performed to maintain the project works in safe and reliable operating condition (several examples are listed below). Clearly indicate when each of the maintenance programs was performed.

- Maintenance of mechanical components of spillway gate hoists and valves;
- Lubrication of radial gate trunnions and other bearings (e.g., fixed wheel gates);
- Maintenance of backup power systems;
- Patching and sealing of concrete;
- Application of joint filler in spillway chutes;
- Scour repairs;
- Etc.

SECTION 6: FIELD INSPECTION OBSERVATIONS AND INTERPRETATION OF MONITORING DATA

The site inspection should be performed in general conformance with the inspection guidelines provided in Bureau of Reclamation, Safety Evaluation of Existing Dams (SEED) Manual. Where the condition of a feature is described, use the following terms (satisfactory, fair, poor, unknown). Qualifying terms such as good, excellent, bad, etc. should be avoided.

6.1 General

The site inspection report shall include the following information:

- Date of inspection.
- Names and affiliations of inspection participants.
- Operating conditions at the time of the inspection, including:
    - Weather conditions on the day of the inspection (note any recent precipitation, which could affect seepage observations);
    - Reservoir and tailrace water surface elevations;
    - Inflows (if known);
    - Releases, including through any spillway(s), outlet works, and powerhouse(s).

For any seismic or hydrologic events that occurred and triggered a special inspection of any project features since the previous Part 12D inspection:

- Identify the date of the event;
- Describe the reason a special inspection was performed (e.g., magnitude of an earthquake, amount of discharge through the spillway, etc.); and
- Ensure that the findings of the inspection are discussed with respect to the relevant project features.

For each project feature, include the subsections listed below. The project features shall be discussed in the same order as listed in Section 2.2 (**Description of Project Features**).

6.2 [Name of Project Feature 1]

6.2.1 Field Inspection Observations

Discuss the observations of the IC Team members during the field inspection. Provide representative photographs with the text or clear references to photographs included in Appendix F (**Inspection Photographs**).

6.2.2 Review and Evaluation of Instrumentation Data and Surveillance

Provide a thorough review and evaluation of any instrumentation data collected to-date. Discuss what constitutes expected behavior of each instrument and identify any trends or unusual data (e.g., outside the expected range or historic range, or indicative of poor instrument maintenance or procedures). Interpret and evaluate the data with respect to performance of the project feature. Include in the body of the report, as needed, annotated snapshots of data along with any statistical evaluation; alternatively, reference that information as provided in Appendix E (**Instrumentation Monitoring Data Plots**).

Provide a summary of the findings of routine or special surveillance performed by the licensee or third-party consultants (e.g., a diver inspection of the upstream face of a concrete gravity dam). This should incorporate a review of licensee inspection checklists, contractor special inspection reports, etc. Evaluate the findings with respect to performance of the project feature.

6.2.3 Evaluation with Respect to Potential Failure Modes

For each identified PFM related to the project feature:

- Provide a clear evaluation of whether the PFM is considered active or developing, based on field observations and the review of instrumentation data and surveillance. If the loading condition did not occur during the report period, state so and limit the evaluation accordingly.
- Document any changed circumstances that could influence the PFM classification (e.g., credible, dismissed, etc.), and briefly evaluate the potential impacts thereof.
- If there are any risk reduction measures in place, evaluate the effectiveness thereof. For any risk reduction measures that were previously recommended but not implemented, provide an evaluation of the stated rationale for not implementing those risk reduction measures.

State whether any field observations, instrumentation data, or surveillance indicates that an unidentified PFM is active or developing. If necessary, address it in the PFMA.

6.2.4 Conclusion

Provide a conclusion with respect to the condition of each project feature and its suitability for continued operation.

6.3 [Name of Project Feature 2]

6.3.1 Field Inspection Observations

6.3.2 Review and Evaluation of Instrumentation Data and Surveillance

6.3.3 Evaluation with Respect to Potential Failure Modes

6.3.4 Conclusion

6.4 [Name of Project Feature 3] etc.

Include additional sections for project features as needed.

6.*X* Overall Interpretation of Instrumentation Data

(*Note: the numbering for this section will depend on the number of project features discussed.*)

Discuss and evaluate any other instrumentation data that is unrelated to specific project features, and any previously-discussed instrumentation data that may, when considered as a whole and not constrained to a single project feature, may provide insight into the site and project performance (e.g., groundwater profile at site).

Evaluate whether any instrumentation readings at the various project features may indicate site or loading conditions that are inconsistent with the current understanding of the project.

SECTION 7: PFMA AND RISK ANALYSIS

7.1 General

Provide a brief summary of the PFMA and risk analysis sessions (e.g., location, dates, attendees and their roles).

Provide a list of key documents or information used in performing the PFMA and risk analysis.

Evaluate the procedures used to perform the PFMA and risk analysis with respect to the established procedures in Chapters 17 and 18 of the Engineering Guidelines and provide an assessment whether the analyses were or were not performed in general conformance with the Engineering Guidelines. List any procedural deviations from the Engineering Guidelines.

7.2 Probabilistic Hydrologic Loading

If a probabilistic hydrologic hazard analysis has been performed:

Provide a brief summary and evaluation of the work that was performed in developing the probabilistic hydrologic loading. Document and review key inputs and assumptions. Include key figures and tables including the probabilistic hydrologic hazard curve. It is not necessary to reproduce all of the information discussed in Section 4.3 (**Hydrology and Project Hydraulics**).

If a probabilistic hydrologic hazard analysis has not been performed: state so.

7.3 Probabilistic Seismic Loading

If a probabilistic seismic hazard analysis has been performed:

Provide a brief summary and evaluation of the work that was performed in developing the probabilistic seismic loading. Document and review key inputs and assumptions. Include key figures and tables including the probabilistic seismic hazard curve. It is not necessary to reproduce all of the information discussed in Section 4.2 (**Seismicity**).

If a probabilistic seismic hazard analysis has not been performed: state so.

7.4 Consequences

If a consequences analysis has been performed:

Provide a brief summary and evaluation of the work that was performed in developing the consequence estimates. Summarize and evaluate the overall methodology used to develop the consequence estimates. Document and review the inundation scenarios, breach assumptions, description of impacted areas, population at risk, and estimated life loss. Document and evaluate key inputs and assumptions in estimating the life loss consequences, including warning times, mobilization times, and fatality rates.

Evaluate estimates for other consequences (economic, environmental, cultural, etc.) if performed.

If a consequences analysis has not been performed: state so and explain, qualitatively, any consequence considerations made for the PFMA.

7.5 PFMA

Provide a brief summary of the work that was performed for the PFMA. Include a listing of the PFMA team members, including the facilitator and location and dates of the PFMA session. Provide a summary and brief description of all considered potential failure modes (tabular form is acceptable) and the final disposition of each PFM considered (ruled-out, excluded, credible, urgent, or insufficient information). The PFMs should be organized by project feature, loading condition, and failure mechanism.

Provide additional discussions (rationale, appropriate actions/studies, etc.) for PFMs that are classified as urgent and insufficient information.

Summarize the major findings and understandings of the PFMA.

If the PFMA report was prepared by the IC team, include a copy of the PFMA report in Appendix I.

If the PFMA report was not prepared by the IC team, then the IC shall provide an evaluation of the PFMA report, as follows.

For each identified PFM:

- Evaluate the full description of the PFM, including the loading conditions, step-by-step progression, adverse and positive factors, disposition, relevant engineering data, potential surveillance and monitoring, risk reduction measures, and conclusions.
- Provide a clear statement of concurrence or non-concurrence with the above listed information and any recommendations.

When evaluating each PFM, the ICs should ensure that the descriptions include thorough documentation of any unusual conditions associated with:

- Design, construction, and foundation geology
- Performance history
- Field inspection
- Field exploration program results
- Seismic and/or hydrologic loadings

- Engineering analysis results
- Surveillance and monitoring results

Provide recommendations as needed to improve the PFMA (e.g., expanding the descriptions, correcting inaccurate information, identifying new PFMs, etc.).

7.6 Risk Analysis and Summary

If a risk analysis has been completed:

Provide a brief summary of the work that was performed for the risk analysis (analyses). Include a listing of the team members, including the facilitator and location and dates of the risk session(s), if different than the PFMA session. Provide a concise description of the risk drivers for the project. Include a tabular summary of the results of the risk analysis and graphical representations as needed (e.g., risk matrix).

For each risk-driver potential failure mode evaluated, describe the failure likelihood and key evidence supporting the assessment. Describe the primary consequence center(s) including proximity to the dam, population at risk, and life loss potential. Be sure to address the following:

- What makes each failure mode more or less likely?
- Which failure modes contribute the greatest risk?
- What uncertainties enter into the estimate of risk?
- What information could be generated to reduce the uncertainty?
- What outcomes could reasonably be expected to result from more info?
- How could the risk be affected by each outcome?
- What are reasonable options/actions, including scope of required effort?

Summarize the major findings and understandings of the risk analysis.

Provide recommendations for any follow on studies.

If the risk analysis report was prepared by the IC team, include a copy of the report in Appendix J.

If the risk analysis report was not prepared by the IC team, then the IC shall provide an evaluation of the report, as follows.

For each PFM evaluated in the risk analysis:

- Evaluate the portrayed risk (failure likelihood and consequence).

- Evaluate if the report provides adequate documentation that supports the portrayal of the risk.
- Provide a clear statement of concurrence or non-concurrence with the risk portrayal and any recommendations.

When evaluating each PFM, the ICs should ensure that the risks reflect any unusual conditions associated with:

- Design, construction, and foundation geology
- Performance history
- Field inspection
- Field exploration program results
- Seismic and/or hydrologic loadings
- Consequences
- Engineering analysis results
- Surveillance and monitoring results

Evaluate if any potential failure modes were excluded from the risk analyses that should not have been.

Provide recommendations as needed to improve the risk analysis (e.g., correcting inaccurate information, revisions to likelihood of failure and consequences, etc.).

If a risk analysis has not been performed, or if the Regional Engineer granted a waiver from performing a risk analysis with the Comprehensive Assessment, state so and reference the date of any letter granting a waiver.

SECTION 8: REVIEW AND EVALUATION OF DAM AND PUBLIC SAFETY PROGRAMS

8.1 Owner's Dam Safety Program

If the project is subject to 18 CFR Part 12, Subpart F:

State that the project is subject to 18 CFR Part 12, Subpart F. Discuss any observations with respect to the implementation of the Owner's Dam Safety Program. The discussion should be based on interactions with licensee staff during preparation, performance, and follow-up related to the Comprehensive Assessment. Unless specifically requested by the FERC, or proposed by the licensee and accepted by the FERC, the IC is not expected to provide a level of detail and evaluation of the ODSP that constitutes an external audit as required by 18 CFR § 12.65.

Human and organizational factors should be identified and assessed, including organizational culture and decision-making authority.

If the project is not subject to 18 CFR Part 12, Subpart F:

State that the project is not subject to 18 CFR Part 12, Subpart F and explain the reasons therefore.

8.2 Dam Safety Surveillance and Monitoring Program

Summarize the frequency and scope of licensee and third-party surveillance of project features, including the inspection of any typically inaccessible features (e.g., toe drains, submerged conduits, etc.). A tabular format is recommended. At a minimum, the following information should be presented:

- Frequency (e.g., daily, monthly, quinquennial, etc.);
- Type of surveillance (e.g., visual, underwater, drone, etc.);
- Project features observed; and
- Who performs the inspection (e.g., operations staff, dam safety engineer, consultant, etc.).

Evaluate whether the current surveillance procedures are sufficient for monitoring for the development of the identified credible PFMs. Assess the frequency of inspection of all project features, including those inaccessible features that are related to identified credible PFMs. As needed, recommend enhancements to the surveillance program to monitor for the development of credible PFMs, as general health monitoring, and for post-event monitoring (e.g., post-earthquake, post-flood, etc.).

Summarize the instrumentation program and data collection. A tabular format is recommended. At a minimum, the following information should be presented:

- Instrument type and location;
- Frequency of manual and automated readings (if applicable); and
- A description of instrument behavior related to environmental factors (e.g., reservoir level, precipitation, temperature, etc.), if applicable.

Evaluate whether the current instrumentation program is sufficient for the detection of the identified credible PFMs. As needed, recommend additional instrumentation to monitor for the development of credible PFMs, as general health monitoring, and for post-event monitoring (e.g., post-earthquake, post-flood, etc.).

8.3 Hazard Potential Classification

Identify the current hazard potential classification, the date of the dam breach analysis, downstream hazard assessment of record, and provide a concise description of the potential impacts of a hypothetical dam failure.

Document any significant changes in the downstream development and any previously unidentified potential impacts within the inundation zone (e.g., critical transportation infrastructure, schools or hospitals, water treatment facilities, etc.). Identify the nearest non-project structure and its approximate distance and time-to-impact from the dam. Describe how the review was performed (e.g., viewed from dam, aerial or satellite imagery, verbal reports from licensee staff, etc.).

Evaluate whether the current hazard potential classification remains appropriate; whether it should be changed; or whether additional investigations are required to determine the appropriate classification.

8.4 Emergency Action Plan

If the project is subject to 18 CFR Part 12, Subpart C:

Identify the dates of the most recent reprint and annual revision of the EAP.

List any EAP activations and tests (annual drills, tabletop exercises, functional exercises, etc.) conducted since the previous Part 12D Report. Evaluate the findings of those activations and tests and state whether any recommended revisions were implemented appropriately.

Discuss the communication methods, response procedures, and EAP training program. Evaluate the adequacy of each.

If the project has a Sudden Failure Assessment (SFA), evaluate the detection, verification, notification, and Emergency Management Agency (EMA) response times. State the total Excess Response Time (ERT) and evaluate any enhancements the licensee has implemented or is considering, including early warning systems. Document any

interviews with first responders, which are strongly recommended if the ERT is less than fifteen minutes. Provide additional recommendations for enhancements as needed.

If the project is required to complete a radiological response plan under 18 CFR § 12.22(c), discuss and evaluate those provisions.

If the project is not subject to 18 CFR Part 12, Subpart C:

State that the project is not subject to 18 CFR Part 12, Subpart C and explain the reasons therefore. If any conditions were identified such that the IC recommends the project prepare an EAP, thoroughly describe and document the conditions. Otherwise, state that the continued exemption is appropriate.

If the project is required to complete a radiological response plan under 18 CFR § 12.22(c), discuss and evaluate those provisions.

8.5 Public Safety Plan

Identify the date of the current PSP. State whether the signs and devices observed during the field inspection were consistent with those described in the plan. Identify any discrepancies observed.

Document any project-related public safety incidents that have occurred since the previous Part 12D Report, as well as the licensee's response and implementation of any required remediation measures. Evaluate the overall effectiveness of the PSP. If needed, recommended improvements to the signage or devices.

8.6 Operations and Maintenance

Evaluate whether any maintenance activities could indicate an active or developing potential failure mode, whether identified or not, and discuss any necessary maintenance that has been deferred and why. Evaluate whether the operations and maintenance programs listed in Section 5.6 (**Summary of Operations and Maintenance Programs**) are considered sufficient for the safe and reliable operation of the project. Recommend any changes as needed related to implementation, training, reporting, etc.

8.7 Spillway Adequacy

Document the review of and evaluate the spillway capacity as required by 18 CFR § 12.39. Document the range of flows that are being considered in the evaluation; if the maximum flood flow considered is less than the PMF, ensure that Section 8.3 (**Hazard Potential Classification**) contains sufficient justification and provide a reference thereto in this section.

Discuss any conditions that may result in the spillway discharging less than its rated capacity, such as:

- Misoperation;

- Failure to operate;
- Blockage; and
- Debilitating damage to the spillway and/or its appurtenances.

For each condition and/or combination thereof, identify the potential effect on discharge and peak reservoir elevation. Evaluate whether the spillway capacity is adequate, based on the above discussion. Recommend further investigation and/or modifications as needed.

8.8 Supporting Technical Information Document

The purpose of this section of the CAR is to document the review of the STID and evaluation of its conformance with Chapter 15 of the Engineering Guidelines, **not to evaluate the analyses themselves**.

Evaluate whether the STID as prepared is suitable as a complete, quick reference for information in the event of a dam emergency. Subsequently, for each section of the STID:

- Evaluate whether the hard copy STID contains all the information required by Chapter 15 of the Guidelines;
- Evaluate whether the information in the hard copy is correct and whether it accurately represents the source material;
- Evaluate whether the references contained on the companion digital reference are comprehensive or if additional materials should be provided; and
- Include recommendations as needed to correct any identified deficiencies.

The sections shall be numbered as shown below to correspond with the sections of the STID.

8.8.1 Potential Failure Modes Analysis and Risk Analysis
8.8.2 Project Description
8.8.3 Construction History
8.8.4 Standard Operating Procedures
8.8.5 Geology and Seismicity
8.8.6 Hydrology and Hydraulics
8.8.7 Dam Safety Surveillance and Monitoring Program
8.8.8 Analyses of Dams and Water Conveyances
8.8.9 Spillway Gates, Other Gates, and Reservoir Control Valves
8.8.10 Pertinent Correspondence Related to the Safety of Project Works
8.8.11 References

APPENDICES FOR THE COMPREHENSIVE ASSESSMENT REPORT

A FERC Letter Requiring Part 12D Inspection

Include only the letter in the hard copy Comprehensive Assessment Report. Any enclosures or attachments to the letter shall be included in the digital copy.

B FERC Letter Approving Part 12D Inspection Plan and IC Team

Include only the letter itself in the hard copy Comprehensive Assessment Report. Any enclosures or attachments to the letter shall be included in the digital copy. If multiple letters were issued (e.g., a conditional approval requesting supplemental information, or an approval of a change in the team members), all shall be included.

C Summary of Independent Consultant's Recommendations

Include a summary table documenting all of the current Independent Consultant's recommendations. This information should be provided in the same order as it is listed in Section 1.6: **Recommendations**. The table should be formatted such that it can be easily repurposed by the licensee for tracking the status of recommendations in future years.

D Project Figures

Include a set of legible figures sufficient to foster a clear understanding of the project features. The level of detail should be informative but not excessive; FERC exhibit drawings can be used. In a departure from previous guidance, this information must be included in the CAR; binding the STID with the CAR to eliminate duplication is no longer an option.

- A general location map, annotated with the location(s) of project facilities, including water conveyances, access routes, major roads, and towns;
- Plan drawings of project facilities;
- Typical sections, elevations, and profiles of key project features (e.g., dams, spillways, powerhouses, intakes, emergency/fuse plug spillways, chute profiles, etc.);
- Typical sections and profiles of water conveyances;
- A satellite or aerial image of the project and downstream area, annotated as needed; and
- Spillway and tailwater rating curves.

Additional information should be provided as needed.

E Instrumentation Monitoring Data Plots

This appendix shall include any instrumentation monitoring data plots and statistical analysis prepared by the IC Team to evaluate the data and performance of project

features, along with any DSSMR plots considered critical to understanding the IC Team's evaluation.

It is not necessary for the printed copy of the CAR to reproduce every plot that has already been provided in an annual Dam Safety Surveillance and Monitoring Report (DSSMR). However, all DSSMRs reviewed by the IC Team should be included digitally with the CAR.

F Inspection Photographs

The hard copy Comprehensive Assessment Report must include representative photographs, either in this appendix or in Section 6: **FIELD INSPECTION OBSERVATIONS AND INTERPRETATION OF MONITORING DATA**.

Digital versions of the inspection photographs shall be provided on the companion digital reference and shall be available as individual files at full resolution. A hyperlinked index, naming convention, or other reference system should be established so photographs can be located easily by reviewers.

G Inspection Checklists and/or Field Notes

Include any inspection checklists and/or field notes digitally with the CAR.

H Operation and Maintenance Documentation

Include any operation and maintenance documentation as needed. Some examples of this type of documentation include:

- Spillway gate testing and trunnion lubrication records;
- Backup power maintenance logs;
- Crack sealing;
- Concrete repairs; and
- Other information as needed.

I Potential Failure Modes Analysis Report

If the PFMA report was prepared by the IC Team and signed by the Independent Consultant(s):

Include a complete copy of the PFMA Report with the CAR. The PFMA Report shall be included digitally and in hard copy, bound separately from the CAR so it can be incorporated as Section 1 of the STID. The PFMA Report shall conform to the requirements provided in Chapter 17 of the Guidelines.

If the PFMA report was prepared by a party other than the IC Team and/or not signed by the Independent Consultant(s):

Include any detailed documentation required to support the IC's evaluation of each PFM. The licensee is required to submit the PFMA report bound separately from the CAR so it can be incorporated in Section 1 of the STID.

J Risk Analysis Report

If the Risk Analysis report was prepared by the IC Team and signed by the Independent Consultant(s):

Include a complete copy of the Risk Analysis Report (RAR) with the CAR. The RAR shall be included digitally and in hard copy, bound separately from the CAR if necessary. The RAR shall conform to the requirements provided in Chapter 18 of the Guidelines.

If the Risk Analysis report was prepared by a party other than the IC Team and/or not signed by the Independent Consultant(s):

Include any detailed documentation required to support the IC's evaluation of project risk. The licensee is required to submit the RAR bound separately from the CAR so it can be incorporated in Section 1 of the STID.

K Independent Calculations

Include any independent calculations performed to evaluate the analyses of record. The full calculations should be included digitally; only include a table of contents in the hard copy CAR.

APPENDIX 16-E OUTLINE FOR THE CA PRE-INSPECTION PREPARATION REPORT

This appendix provides the outline for the Pre-Inspection Preparation Report on a Comprehensive Assessment conducted in accordance with 18 CFR § 12.37. Any Comprehensive Assessment Pre-Inspection Preparation Report (CA-PIPR) is required to follow this format and provide the appropriate information in each section. The requirement to provide a CA-PIPR is established in 18 CFR § 12.40(f)(2).

Several important notes regarding this appendix:

- **This outline generally provides only the section headings.** Unless otherwise indicated, the information required in each section is the same information required in the corresponding section of the Comprehensive Assessment Report (CAR), an outline of which is available as Chapter 16, Appendix D. The sections have been renumbered in the CA-PIPR though the sequential order is the same.
- Clarification is provided in some cases to limit the expected depth of information provided in the CA-PIPR. However, the more detail that is provided in the CA-PIPR, the better prepared the team will be for the field inspection, PFMA and RA session(s), and preparation of the CAR.
- **Any evaluations and conclusions in the CA-PIPR are considered preliminary.** It is entirely acceptable, and even expected, for the IC Team to acquire new information or a different understanding of the project and its components between completion of the CA-PIPR and the CAR. **The FERC does not intend to compare the CA-PIPR to the CAR to identify changes in evaluations or conclusions.**
- The phrase “the previous Part 12D Report” refers to the most recent report on a Periodic Inspection, Comprehensive Assessment, or an inspection performed in accordance with the rules established by FPC Order 315 or FERC Order 122.

GENERAL PROVISIONS

Cover Page

The cover page must include, at a minimum:

- Project name and number;
- The name of each Independent Consultant and, if applicable, the consulting firm each represents;
- The date of the Comprehensive Assessment Pre-Inspection Preparation Report (CA-PIPR).

Table of Contents

Include a table of contents listing each section of the CA-PIPR and page numbers. Include separate lists of tables and figures.

Identification of IC Team

- Identify each member of the Independent Consultant Team and their role. Attach resumes for those IC Team members whose resumes were not included with the Part 12D Inspection Plan.

SECTION 1: DESCRIPTION OF PROJECT FEATURES AND OPERATIONS

1.1 Location and Purpose

1.2 Description of Project Features

1.3 Summary of Operations

SECTION 2: REVIEW AND EVALUATION OF DESIGN BASIS AND CONSTRUCTION

2.1 Engineering Geology

2.1.1 Regional Geology

2.1.2 Site Geology

2.1.3 Foundation Explorations

2.1.4 Geologic Hazards

2.2 Dam

2.2.1 Design Considerations

2.2.2 Foundation Excavation and Treatment

2.2.3 Materials and Placement

2.2.4 Construction Details

2.2.5 Modifications

2.3 Spillway

2.4 Outlets

2.5 Powerplant

2.6 Other Structures

2.7 Mechanical

2.7.1 Spillway

2.7.2 Outlets

2.7.3 Powerhouse

SECTION 3: REVIEW AND EVALUATION OF PREVIOUS ANALYSES

3.1 Geology

3.2 Seismicity

3.3 Hydrology and Project Hydraulics

3.3.1 Precipitation and Snowmelt

3.3.2 Flood Loading and Routings

3.3.3 Dam Breach Studies

3.4 Analyses of Project Features

3.4.*X* Analyses of [Project Feature X]

3.4.*X*.1 Static Analyses of [Project Feature X]

Stress and Stability

Foundation Stability

Seepage and Internal Erosion

3.4.*X*.2 Seismic Analyses of [Project Feature X]

Seismic Loading

Dynamic Stress and Stability Analyses

Liquefaction Analyses

Post-Liquefaction Stability

Deformation Analyses

3.4.*X*.3 Hydraulic and Overtopping Analyses of [Project Feature X]

Hydraulic Analyses

Overtopping and Erosion Analyses

Transient Analyses

3.4.*X*.4 Other Analyses of [Project Feature X]

SECTION 4: PROJECT STATUS

4.1 Modifications to Project Works

4.2 Modifications to Project Operations

4.3 Recommendations from Previous Part 12D Reports

4.4 Outstanding/Ongoing Studies

4.5 Completed Studies

4.6 Summary of Operations and Maintenance Programs

SECTION 5: INTERPRETATION OF MONITORING DATA

5.1 General

For each project feature, include the subsections listed below. The project features shall be discussed in the same order as listed in Section 1.2 (**Description of Project Features**).

5.2 [Name of Project Feature 1]

5.2.1 Review and Evaluation of Instrumentation Data and Surveillance

Provide a thorough review and evaluation of any instrumentation data collected to-date. Discuss what constitutes expected behavior of each instrument and identify any trends or unusual data (e.g., outside the expected range or historic range, or indicative of poor instrument maintenance or procedures). Interpret and evaluate the data with respect to performance of the project feature. Include in the body of the report, as needed, annotated snapshots of data along with any statistical evaluation; alternatively, reference that information as provided in Appendix B (**Instrumentation Monitoring Data Plots**).

Provide a summary of the findings of routine or special surveillance performed by the licensee or third-party consultants (e.g., a diver inspection of the upstream face of a concrete gravity dam). This should incorporate a review of licensee inspection checklists, contractor special inspection reports, etc. Evaluate the findings with respect to performance of the project feature.

5.3 [Name of Project Feature 2]

5.3.1 Review and Evaluation of Instrumentation Data and Surveillance

5.4 [Name of Project Feature 3] etc.

Include additional sections for project features as needed.

SECTION 6: REVIEW AND EVALUATION OF DAM AND PUBLIC SAFETY PROGRAMS

6.1 Owner's Dam Safety Program

6.2 Dam Safety Surveillance and Monitoring Program

6.3 Hazard Potential Classification

6.4 Emergency Action Plan

6.5 Public Safety Plan

6.6 Operations and Maintenance

APPENDICES FOR THE CA PRE-INSPECTION PREPARATION REPORT

A Project Figures

Include a set of figures sufficient to foster a clear understanding of the project features. The level of detail should be informative but not excessive; FERC exhibit drawings can be used.

- A general location map, annotated with the location(s) of project facilities, including water conveyances, access routes, major roads, and towns;
- Plan drawings of project facilities;
- Typical sections, elevations, and profiles of key project features (e.g., dams, spillways, powerhouses, intakes, emergency/fuse plug spillways, chute profiles, etc.);
- Typical sections and profiles of water conveyances;
- A satellite or aerial image of the project and downstream area, annotated as needed; and
- Spillway and tailwater rating curves.

Additional information should be provided as needed.

B Instrumentation Monitoring Data Plots

This appendix shall include any instrumentation monitoring data plots and statistical analysis prepared by the IC Team to evaluate the data and performance of project features, along with any DSSMR plots considered critical to understanding the IC Team's evaluation.

It is not necessary for the printed copy of the CA-PIPR to reproduce every plot that has already been provided in an annual Dam Safety Surveillance and Monitoring Report (DSSMR). However, all DSSMRs reviewed by the IC Team should be included digitally with the CA-PIPR.

APPENDIX 16-F OUTLINE FOR THE CA REVIEW MEETING PRESENTATION

This appendix provides a brief outline for a Comprehensive Assessment Review Meeting Presentation.

1. Title Slide (dam name, state, FERC regional office, dam owner/licensee, photograph)
2. Project Location Map
3. Project Team (names and roles for IC team and facilitators)
4. Project Description (include key drawings)
5. Summary of Review of Design, Construction, and Analysis
6. Review of STID
7. Key Field Inspection Findings
8. Review of Dam Safety Surveillance and Monitoring Report
9. Summary of PFMA (overall summary of PFMs)
10. Loading Curves (hydrologic and seismic)
11. Consequence Summary (life loss, economic, and other)
12. Risk Analysis Summary (risk plot, discussion of risk-driving PFMs)
13. Review of Dam and Project Safety Programs (ODSP, DSSMP, EAP, PSP, O&M, etc.)
14. Summary of Findings and Recommendations (key findings, status of outstanding recommendations, summary of new recommendations)

Document Content(s)