

Performance Assessment Manual

Appendix 2.02 - Assessment of Best Practices for Unit and Plant Performance Processes



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ASSESSMENT OF BEST PRACTICES FOR UNIT AND PLANT PERFORMANCE PROCESSES

Best Practices for Unit and Plant Performance Processes - This draft protocol describing best practices for unit and plant performance processes of hydroelectric facilities addresses three aspects related to operational performance. This protocol and these aspects are inspired by, and, in part, derived from, the International Hydropower Association's *Sustainability Guidelines* [IHA, 2004] and *Sustainability Assessment Protocol* [IHA, 2006].

Implementation of comprehensive best practices for unit and plant performance is critical for justifying and verifying increased generation through more efficient turbines and generators, improved automation and control systems, and advanced optimization systems. Improved efficiency can provide increased generation, increased revenue, additional water supply, and reduced maintenance costs, contributing directly to the goals of the IHA's *Sustainability Assessment Protocol* and to the goals and objectives of the Hydropower Advancement Project.

The rating scores from the protocol are useful for: (1) assessing hydropower unit and plant efficiency; (2) comparing the relative performance of units and plants within a system; (3) providing guidance for allocating capital and maintenance resources; (4) prioritizing and justifying upgrades and improvements; and (5) verifying and documenting efficiency and generation improvements [March et al., 2005; Schofield and March, 2008; March, 2008].

Scoring for this best practices protocol is based on the following system:

- 5 points for each aspect where the hydro facility meets all of the relevant criteria;
- 3 points where most of the criteria are met;
- 1 points where only some of the criteria are met; and
- 0 points where none of the criteria is met.

Overview details for the hydroelectric facility under appraisal are shown in Tables 2.02-1 and 2.02-2. Three best practices aspects for unit and plant efficiency are listed in Tables 2.02-3 through 2.02-5. Aspects P1 to P3 relate to the economic aspects of unit and plant efficiency.

Guidance on scoring is provided for each aspect. Scores can be totaled and divided by the number of aspects to obtain an average or converted to a percentage score. Unit scores are

typically generation-weighted to provide a facility score. The resulting scores can be displayed in a variety of ways, depending on individual preferences.

Table 2.02-1: Facility Overview Details for Appraisal of Best Practices for Unit and Plant Performance Processes

PLANT NAME	
LOCATION DETAILS	
DATE OF ASSESSMENT	
NAME AND POSITION OF PERSON CARRYING OUT ASSESSMENT	
DETAILS OF OTHERS CONSULTED DURING ASSESSMENT	
SIGNATURE OF AUTHORIZING OFFICER	

Table 2.02-2: Summary of Aspects and Scores for Appraisal of Best Practices for Unit and Plant Performance Processes

No.	Aspect	Score	No.	Aspect	Score
P1	Unit performance data for economic operations		P3	Integration with economic business policies, processes, and systems	
P2	Organizational utilization of performance data for economic operations				
	Total	Average	Percentage	Range	
	Score				
	Comments				

Table 2.02-3: Aspect P1, Unit Performance Data for Economic Operations

P1 - Data			
Valid unit performance data provides the basic foundation for effective hydro performance processes.			
Performance Processes Scoring			
5 = Highest	<ul style="list-style-type: none"> • Turbine and generator (i.e., unit) performance characteristics consistent with relevant international and/or national standards (e.g., IEC 60041-1991-11, ASME PTC18-2002) are available for each generating unit over the entire range of operating heads. • Performance-related data consistent with relevant international and/or national standards, including power, headwater elevation, tailwater elevation, flow rate, water temperature, gate opening, trash rack differential, and blade angle (where appropriate) are continually measured and readily available for each generating unit. • Adequate personnel, budgets, systems, processes, and procedures are in place to properly manage and maintain performance-related instrumentation, including obsolescence management for hardware and software and succession planning for personnel; to periodically compare expected performance characteristics for each unit with measured performance characteristics; to periodically evaluate and train relevant personnel; and to take timely and appropriate action when necessary. 		
3 = Medium	<ul style="list-style-type: none"> • Unit performance characteristics consistent with relevant international and/or national standards are available for most units (i.e., 50% or more of total generation) over most of the range of operating heads, and relative unit performance characteristics based on index testing are available for the remaining units. • Performance-related data consistent with relevant international and/or national standards, including power, headwater elevation, tailwater elevation, flow rate, water temperature, gate opening, trash rack differential, and blade angle (where appropriate) are continually measured and readily available for most units, but some flow rates are relative rather than absolute. • Significant personnel, budgets, systems, processes, and procedures are in place to properly manage and maintain performance-related instrumentation. However, some improvements could be readily achieved. 		
1 = Low	<ul style="list-style-type: none"> • Unit performance characteristics consistent with relevant international and/or national standards are available for some units over some of the range of operating heads, and relative unit performance characteristics based on index testing are available for some (i.e., 20% or less of total generation) of the remaining units. • Some performance-related data, including power, headwater elevation, tailwater elevation, flow rate, water temperature, gate opening, and blade angle (where appropriate) is available for some units, but most flow rates are relative rather than absolute. • Some personnel, budgets, systems, processes, and procedures are in place, but these are generally ineffective and/or inadequate. 		
0 = Zero	<ul style="list-style-type: none"> • No unit performance characteristics are available, and no attention is paid to performance-related instrumentation, data, or personnel. 		
Comments			
	<table border="1" style="float: right;"> <tr> <td style="background-color: #cccccc;">Score</td> <td style="width: 50px;"></td> </tr> </table>	Score	
Score			

Table 2.02-4: Aspect P2, Organizational Utilization of Performance Results

P2 – Utilization	
Proper utilization of valid performance results throughout the organization is required for cost-effective operations.	
Performance Processes Scoring	
5 = Highest	<ul style="list-style-type: none"> Unit performance characteristics and past performance test results consistent with Aspect P1 are readily available to appropriate personnel (e.g., operations, maintenance, engineering, power management, water management, environmental management) and systems (e.g., monitoring system, automation system, optimization system, maintenance management system, environmental management system) within the organization and are used in the long-term, medium-term, short-term, and real-time optimization of unit/plant and system operations for relevant operational modes (e.g., specific power, specific flow, most efficient power, most efficient power within a range, conventional AGC, optimization-based AGC). Real-time and archival performance-related data consistent with Aspect P1, as well as supplementary performance-related information (e.g., unit operational data; electrical, mechanical, and hydraulic operational limits; power/energy and ancillary services rates versus time; operational scheduling information such as unit status and schedule request;) are securely stored, appropriately backed-up, and readily available to appropriate personnel and systems within the organization. Systems, processes, and procedures are in place to periodically compare expected performance data for each unit with real-time and archival performance-related data and supplementary performance-related information to ensure that improvements and corrections to performance characteristics are incorporated in a timely fashion into all appropriate optimization systems and related procedures, such as operator guidelines. Adequate personnel, budgets, systems, processes, and procedures are in place to properly manage and maintain performance-related communications infrastructure, archival software with appropriate data compression settings, operator-based and/or automation-based optimization infrastructure and software, including obsolescence management for hardware and software and succession planning for personnel; to periodically review performance-related data and information; to periodically evaluate and train relevant personnel; and to take timely and appropriate action when necessary.
3 = Medium	<ul style="list-style-type: none"> Unit performance characteristics and past performance test results consistent with Aspect P1 are readily available to appropriate personnel and systems within the organization for most units (i.e., 50% or more of total generation) and are used for most units in the long-term, medium-term, short-term, and real-time optimization of unit/plant and system operations for relevant operational modes. Real-time and archival performance-related data consistent with Aspect P1, as well as supplementary performance-related information, are securely stored, appropriately backed-up, and readily available to appropriate personnel and systems within the organization for most units. Systems and procedures are in place for most units to periodically compare expected performance data for each unit with real-time and archival performance-related data and supplementary performance-related information. Significant personnel, budgets, systems, processes, and procedures are in place to properly manage and maintain performance-related communications infrastructure, archival software, and operator-based and/or automation-based optimization infrastructure and software. However, some improvements could be readily achieved.
1 = Low	<ul style="list-style-type: none"> Unit performance characteristics and past performance test results are available to appropriate personnel and systems within the organization for some units (i.e., 20% or less of total generation) over some of the range of operating heads. Real-time and archival performance-related data, as well as supplementary performance-related information, are stored and available to appropriate personnel and systems within the organization for some units and are used in the long-term, medium-term, short-term, and real-time optimization of unit/plant and system operations for relevant operational modes for some units. Some personnel, budgets, systems, processes, and procedures are in place, but these are generally ineffective and/or inadequate.
0 = Zero	<ul style="list-style-type: none"> No unit performance characteristics are available, and no attention is paid to performance-related instrumentation, data, or personnel.
Comments	
Score	

Table 2.02-5: Aspect P3, Integration with Business Policies, Processes, and Systems

P3 - Integration			
Integration of the performance data and related information into the organization’s business policies, processes, and systems is required.			
Performance Processes Scoring			
5 = Highest	<ul style="list-style-type: none"> Unit performance characteristics, consistent with Aspects P1 and P2, are used in the evaluation and quantification of economic losses associated with optimization systems, instrumentation, avoidable losses, unit/plant scheduling, environmental operations, and operational impacts on maintenance (e.g., AGC operation, exceeding cavitation limits, rough zone operation). Systems, processes, and procedures, consistent with Aspects P1 and P2, are in place to compute quantitative performance metrics which ensure that relevant economic results are available for establishing maintenance priorities, developing capital equipment priorities, and evaluating operational policies, such as: (1) a timely comparison of actual operations to optimized operations under the same conditions; (2) a timely comparison of expected (i.e., historical) performance data for each unit with real-time and/or archival performance-related data to ensure that improvements and corrections to performance characteristics and instrumentation are incorporated in a timely fashion; (3) a timely evaluation of avoidable energy losses (e.g., trash rack fouling, penstock/tunnel fouling, penstock/tunnel degradation); (4) a timely evaluation of unit/plant scheduling. Adequate personnel, budgets, systems, processes, and procedures are in place (1) to properly manage and maintain the infrastructure and software for integrating performance-related data and related information into the organization’s business policies, processes, and systems, including obsolescence management for hardware and software and succession planning for personnel; (2) to periodically evaluate and train relevant personnel; and (3) to take timely and appropriate action when necessary. 		
3 = Medium	<ul style="list-style-type: none"> Unit performance characteristics, consistent with Aspects P1 and P2, are used in the evaluation and quantification of economic losses associated with optimization, instrumentation, avoidable losses, and unit/plant scheduling for most units (i.e., 50% or more of total generation). Systems, processes, and procedures, consistent with Aspects P1 and P2, are in place for most units to compute quantitative performance metrics. Significant personnel, budgets, systems, processes, and procedures are in place to properly manage and maintain the infrastructure and software for integrating performance-related data and related information into the organization’s business policies, processes, and systems. However, some improvements could be readily achieved. 		
1 = Low	<ul style="list-style-type: none"> Unit performance characteristics are used in the evaluation and quantification of economic losses associated with optimization, instrumentation, avoidable losses, and unit/plant scheduling for some units (i.e., 20% or less of total generation). Systems, processes, and procedures are in place for some units to compute quantitative performance metrics. Some personnel, budgets, systems, processes, and procedures are in place, but these are generally ineffective and/or inadequate. 		
0 = Zero	<ul style="list-style-type: none"> No unit performance characteristics are available, and no attention is paid to performance-related instrumentation, data, or personnel. 		
Comments			
	<table border="1" style="float: right;"> <tr> <td style="background-color: #cccccc;">Score</td> <td style="width: 50px;"></td> </tr> </table>	Score	
Score			

For overall questions
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