

Staff Report

TO: Board of Directors

FROM: Keane Sommers, P.E., Hydroelectric Manager
Kaylie Hague, Hydroelectric Compliance Technician

DATE: May 11, 2022

SUBJECT: Nevada Irrigation District Internal Compliance Program 2021
Annual Risk Assessment Report Summary

HYDROELECTRIC

RECOMMENDATION:

Receive and file the NID 2021 Annual Risk Assessment Report as prepared in accordance with the Nevada Irrigation District Internal Compliance Program.

BACKGROUND:

As authorized by NID Board Policy 9400, the NID Internal Compliance Program (Section 5.4) requires that an Annual Compliance Review and Risk Assessment be performed. A summary of the results is to be presented to the General Manager and the Board of Directors.

Annual Risk Assessment Summary

Organizations with a strong risk management culture have successfully demonstrated that implementation of Internal Risk Controls Systems (IRCS) are integral to anticipate, predict, and govern operational and compliance risk elements. In its effort to implement such an IRCS, the NID Internal Compliance Program requires the NID Reliability Oversight Compliance Committee (ROCC) to commission an annual risk assessment that identifies weaknesses and vulnerabilities in NID hydroelectric reliability, compliance, and security positions.

In late 2021 and early 2022, NID and Grid Subject Matter Experts (GridSME) performed a risk assessment of the NID Hydroelectric Department reliability, compliance, and security efforts. The risk assessment focused on the following five major components:

1. People and Training

2. Regulatory Environment
3. Operating Environment (such as wildfires and security)
4. Infrastructure and Technology
5. Electricity Revenue

Results were documented in an Annual Risk Assessment Report (Report) associated with current existing risks and the mitigation efforts deployed by NID.

Although NID has a low inherent risk to the Bulk Electric System (BES) due to its relatively small amount of electrical generation and its location on the Western Interconnection network topology, NID is not without risk to its organization, community, or BES that is evoked by the regulatory, staffing, equipment and external challenges identified in the 2021 Annual Risk Assessment Report.

During 2021, NID Hydro performed well in mitigation of risks identified in the prior year's risk assessment. Significant achievements in 2021 included: reliability of hydroelectric facilities through scheduled maintenance, repairs, and upgrades; continued implementation and revision of the Capital Investment Program, vegetation management and wildfire mitigation on conveyance and transmission line facilities; and continued compliance with environmental and electric reliability standards. NID Hydro is making a concerted effort to implement and improve the internal risk control system which, is evident through the ICP and ROCC activities performed, and the continued proactive effort to implement cyber security policies and controls over the SCADA system.

With the key risk areas identified in the Report, NID will continue to move forward with risk prioritization, reduction, mitigation and elimination efforts.

BUDGETARY IMPACT:

No budgetary impact.

Initials

KSH

Attachments: (1)

- NID 2021 Annual Risk Assessment

2021 Annual Risk Assessment

NID Hydroelectric Department



Executive Summary

The Nevada Irrigation District's Hydroelectric Department ("NID Hydro" or "the Department") faces a variety of risks that, individually or collectively, threaten the organization's ability to meet its objectives. This report identifies and assesses the most prominent risks, provides an update on status relative to prior years, and offers recommendations for how NID Hydro can mitigate those risks.

The following five categories were identified during the 2021 risk assessment. The themes are consistent with the previous year's assessment as are the rankings.

1. People and Training
2. Regulatory Environment
3. Operating Environment (e.g., wildfires)
4. Infrastructure and Technology
5. Electricity Revenue

NID Hydro continues to face significant risks in the People and Training category, including a lack of bench strength in certain key areas, talent recruitment and retention, personnel training, and an aging workforce. The impacts of the COVID-19 pandemic and the results of the 2021 union negotiations and market compensation adjustments continue to strain NID resources. NID Hydro's ability to both retain its best people and train its less experienced employees continue to be a critical risk. If unmitigated, the combination of these personnel risk factors would adversely impact NID Hydro's operations and performance. Bringing the right people into the organization, compensating them competitively with nearby agencies, training them, building redundancy in a few key areas, and retaining the top performers, are fundamental to managing all other risks.

NID Hydro's operating environment presents high inherent risks. The organization's rural and mountainous operating footprint experiences treacherous conditions in the winter followed by long, dry seasons in the summer and fall. This environment coupled with NID Hydro's high-voltage electrical equipment and aging infrastructure creates numerous risks to NID's people and property. In 2021, NID Hydro responded well to these risks as it experienced no lost time accidents and mitigated its high fire risk thanks to the vegetation management program.

One other external risk NID must respond to are cyber threats to its business and critical infrastructure. The current IT infrastructure and resourcing availability for NID is a risk as the current structure and support from District resources lead to longer than normal response times with respect to cyber security and infrastructure. NID's Corporate network experienced a cyber security event that paralyzed NID Hydro's business operations with affects still felt in Q1 of 2022.

Prominent regulatory risks facing NID Hydro include the Federal Energy Regulatory Commission (FERC) dam safety requirements, the FERC approval of the Deer Creek Project transfer, the FERC relicensing effort, the North American Electric Reliability Corporation (NERC) Reliability Standards, increasing State Water curtailments which include increased data gathering/submissions and Resource Agency coordination, the increasing involvement in project operations from various Resource Agencies (e.g., USFS, USFWS, CDFW, SWRCB, NMFS), and the associated pace of change and continuous demands from those regulatory agencies. The culmination of these external demands put strain on NID Hydro's workforce and workloads.

The FERC dam safety regulatory oversight continues to increase and managing the volume of work in this area is a challenge, especially with the current Dam Safety Engineer planning to retire in the first half of 2022. NID currently has 15 dams under federal and state jurisdiction and seven are classified as high hazard dams. Even with an experienced team, the sheer volume of regulatory requirements and the size of NID's infrastructure footprint culminates in a significant strain on NID Hydro resources to stay current on regulatory changes and maintain the associated internal compliance programs. NID has been short-staffed in this area and now with the Dam Safety Engineer's retirement in 2022, the District is extremely vulnerable in this area.

NID Hydro must take steps to close the gaps addressed in this report. The most prominent areas needing attention and meaningful action include recruiting, hiring, training, and retaining skilled resources to manage NID Hydro's growing infrastructure and regulatory burdens, managing and mitigating operating environment risks, including wildfires and cyber threats, and maintaining the reliability of an aging infrastructure. There are a multitude of risk factors facing NID Hydro, but all are manageable with the right people and right resources.

Risk Assessment

Failing to identify and manage risk prevents organizations from reaching safety, operations, financial, reliability, and compliance objectives. The effective deployment of strong internal controls, systems, and other risk management tools helps organizations identify latent organizational weaknesses, potential human behaviors that drift from expectations, and external risk factors. Risk management programs are the foundation to a business resiliency plan. This annual risk assessment represents one of many steps NID Hydro takes to manage and mitigate risk.

In January 2022, GridSME met with several key NID Hydroelectric Department ("NID Hydro") management and staff members to discuss and assess current and potential risk factors facing NID Hydro operations. As part of this assessment, GridSME interviewed the Hydroelectric Dam Safety Engineer, the Hydroelectric Manager, the Hydroelectric Compliance Analyst, two Senior Hydroelectric System Technicians, the Hydroelectric Generation Superintendent, the Hydroelectric Maintenance Superintendent, and the Hydroelectric Project Manager. This tabletop risk assessment exercise identified five main risk categories facing NID Hydro listed in order of priority below:

1. People and Training
2. Regulatory Environment
3. Operating Environment (e.g., wildfires)
4. Infrastructure and Technology
5. Electricity Revenue

A variety of specific risks reside within each category. Interdependencies exist among the risk categories, and certain risks can positively or negatively impact other risks. This risk assessment identifies the risks believed to be most probable or most impactful to NID Hydro.

People and Training

Our risk assessment process identified People and Training to be the most probable and impactful risk discussed by the interviewees. Within this category, several risks were identified that could hinder NID Hydro's ability to recruit, train, and retain the workforce necessary to operate and maintain its hydroelectric infrastructure. These risks include, workplace safety, talent recruitment and retention, personnel training, and succession planning.

A simple high-level observation made during our risk assessment is NID Hydro's headcount change year-over-year. NID Hydro had a budget for 35 FTEs in 2021 but only 30 FTEs in 2022. This is a major concern given the growing portfolio footprint and increasing regulatory burden.

Personnel Training

Access to external training continues to be a top priority and key risk facing NID Hydro and other water agencies in Northern California. Due to COVID, NID lost access to the PG&E operator onsite training program, which again highlighted NID's vulnerability and heavy reliance on PG&E for its operator training needs. This has been a consistent theme over the past few years as NID Hydro sees a well-trained and prepared workforce essential to maintaining a culture of safety, its infrastructure, and uninterrupted operations. In addition to Hydro Operator training, training for other key trades such as Elec-Tech/SCADA classifications and Machinist classifications has mostly been left to OJT training as opposed to formal training. Although, NID began leveraging a few external training outlets for certain operator job functions in recent years.

NID Hydro recognizes that a well-developed training program must contain both internal and external components. Internal training is necessary to prepare the workforce for the operating environment, procedures, and scenarios unique to NID Hydro. External training is essential for personnel to gain exposure to proven industry best practices, deep technical knowledge and skillsets, external viewpoints, and new developments.

Operations

For its operations personnel, NID Hydro remains heavily dependent on PG&E's hydro operations training program. NID Hydro has a long history of using PG&E's training program to qualify its operators. This training program has been extremely beneficial for NID Hydro and its personnel. Because of this, in 2016, NID Hydro cited the potential loss of an adequate training

program as a major risk facing NID Hydro and began taking long-term steps to mitigate this risk since that time.

Absent access to PG&E's training program, NID Hydro would be forced to look for other hydro training programs. Interviewees identified WAPA's Training Center in Boulder, Colorado as the closest replacement to PG&E's operator training program. However, this training is not as in-depth as PG&E's training and would likely lead to training gaps for new NID operators. Therefore, NID Hydro continues to explore longer-term in-house training development options to reduce the organization's dependency on third-party training. This development includes a Hydro-Operator Apprenticeship program that is currently under review by the Union.

Access to outside, third-party training programs is a single-contingency risk with considerable downside to NID Hydro. These third-party training programs accelerate operators' learning curve and cuts on-the-job training duration in half, one interviewee noted. What might normally take an operator 18 months to learn and become proficient can be cut in half to nine months when they go through PG&E's operator training program.

This is no small effort and will take years to develop but is essential should NID Hydro lose access to PG&E's operations training program. NID Hydro has also had preliminary discussions with neighboring water agencies (e.g., Placer County Water Agency, Yuba County Water Agency, Merced Irrigation District, etc.) about forming a training partnership to pool resources and form a shared training program. There is mutual interest in this effort, but resources are scarce across the agencies, and NID Hydro cannot not rely on outside agencies to mitigate this risk.

Maintenance

Currently, the NID Hydro Maintenance department (machinists and technicians) relies mostly on external training classes and vendor training programs. In prior years' risk assessments, it was noted that the maintenance department, unlike the operations department, lacks a formal systematic training program, instead relying on a mostly ad hoc approach. The current informal maintenance department training program consists of both third-party and internally provided training activities. The lack of a formal, documented program is a risk to the long-term success of NID Hydro. As it stands today, NID is at risk of substantial tribal knowledge leaving the organization in the event of retirements and turnover.

Talent Recruitment and Retention

Consistent with the prior years' risk assessment, talent recruitment and retention remains a significant risk to NID Hydro's continued success. In 2018, 2019, 2020, and 2021, the employee turnover rate in the Department was 10.0%, 9.8%, 6.6%, and 15.5%, respectively. In 2021, NID Hydro lost two hydro operators – one to NID Water Maintenance, the other and one Senior Electrical Technician to other agencies, one Compliance Administrator to consulting, and one Senior Electrical Machinist to retirement. Even with recent wage adjustments from salary surveys and union negotiations, NID Hydro fears it is in a weak position to recruit and retain top talent. This risk was raised again by all interviewees during our 2021 risk assessment interview process. The District and Employee Union completed contract negotiations in 2021 with some

resolution on salary. However, pay remains below nearby agencies. For example, an NID Hydro Operator is \$5,000 to \$15,000 annual salary below comparable positions at PG&E, Placer County Water Agency, and Yuba County Water Agency.

In 2021, NID held Union MOU negotiations that had been delayed in 2020 due to COVID. The outcome of these negotiations was met with mixed reactions as the salary survey adjusted salaries for certain classifications, while leaving others with minimal gains. Interviewees still believe that even after the salary adjustments, Hydro is highly susceptible to employee turnover as wages remain below market averages. A market compensation survey was conducted in 2021 and was considered during Union MOU negotiations in 2021. In addition to the 2% COLA raises, a salary survey will be performed no later than six (6) months prior to the expiration of the MOU in December of 2023.

The full impact of the 2021 pay rate changes will fully play out as retirements increase and the workforce age and tenure decline. While personnel nearing retirement are inclined not to leave a job simply for better near-term pay, a younger, well-trained workforce is far more prone to seek immediate pay raises simply by changing their employer. The risk assessment interviewees continued to have concerns that NID Hydro's below market compensation rates leave the organization vulnerable to being a "training shop" for other nearby water agencies, irrigation districts, and PG&E. In such a scenario, NID Hydro becomes a revolving door for smart, hungry talent that climb the learning curve with NID, only to become too valuable to stay at NID. They leave NID for better paying comparable positions at other organizations in the surrounding geographic area. As mentioned above, this occurred in 2021 with the District seeing two tenured and highly knowledgeable resources leave the Department to other agencies.

Due to likely retirements and general workforce attrition, NID Hydro is likely to lose a meaningful portion of its workforce over the next three years as approximately 12% of the Department is currently eligible for retirement. Based on recent turnover statistics and expected retirements, NID Human Resources estimates that an annual turnover rate of approximately 12% should be expected. High employee turnover has the potential to exacerbate other risk factors facing NID Hydro as addressed within this report. These include employee safety, personnel training, equipment maintenance, and regulatory compliance. These risks become more difficult to manage and become more impactful when organizations lack skilled, experienced, and well-trained people.

Facing the risk of high employee turnover, organizations should not only improve its employee recruitment and retention strategy, but also institute a more robust succession plan. Faced with the real possibility of a 12% employee turnover rate, NID Hydro must place more attention on succession planning at all levels of the department. Succession planning is a tool used to develop the right competencies and leadership attributes at all levels of the organization. In addition, a succession plan also identifies where the lack of bench strength creates single-contingency risks that leave NID Hydro highly vulnerable in the event of a surprise departure.

Should NID Hydro experience increased turnover in the years ahead, which is likely inevitable given retirements, interviewees expressed a concern about NID Hydro's ability to find and

recruit experienced and qualified staff. It is believed that the overall workforce is not sufficiently deep in terms of the industrial trades. This external factor places even more emphasis on the importance of well-developed employee retention and succession plans.

Succession Planning

The risk of turnover and a challenging recruiting environment make succession planning a key initiative in maintaining an adequate workforce. Interviewees all mentioned succession planning as a risk factor in our 2021 interviews and are all mindful of this need and there are efforts being made to develop the bench strength.

For Hydro Operations specifically, succession planning is a common risk factor mentioned during the interviews. The identification of this risk is an important and necessary first step to mitigating the risk. The risk is two-fold. First, there is a concern the operations department lacks strong candidates interested in a future leadership role in the department. Second, it is widely believed that operators take five years to get their feet under them and move into “experienced” status. Because of the time required for operators to reach “experienced” status, this puts NID Hydro at risk when turnover does occur.

In 2021, the Hydro Operations Department added two new resources who come to NID with limited experience but were the most qualified candidates of the applicants. They will require considerable training investments and time on the job, but both demonstrate the right skillsets and competencies to perform well in their roles long-term. In hiring for these two positions, NID noted that they did not receive any applications from qualified candidates that already had experience and training in hydro facility operations. A data point that suggests NID’s pay levels are below market.

The Hydro Maintenance Department practices back-filling and cross-training to cover vacations. The department is also looking ahead 5 to 10 years and identifying the personnel that will be able to step-up into more experienced and skilled roles. This exercise also influences training program development, which is a critical step in succession planning. To grow its bench strength, NID Hydro must know what skills they need at the next level and the training and on-the-job experience required for personnel to advance in the organization.

Personnel Safety

All of the interviewees view personnel safety as an extremely important risk facing NID Hydro. Given the remote working environments and treacherous weather conditions common in the Western Sierras, personnel’s continuous exposure to these elements presents a significant risk. Because of this, NID Hydro operations and maintenance crews make a concerted effort to take preventive measures and prepare in advance of incoming storms and deploy the buddy system whenever possible.

A common topic during our interviews is the slate of storms that hit the NID Hydro headquarters and surrounding areas in late 2021. The impact to Hydro operations and to NID facilities was significant as power in the surrounding areas was shut-off for a few weeks. This

included power to the generating units as the incoming lines awaited repair from PG&E. Personnel safety during these situations is challenging as access to remote locations and communications are difficult to maintain which leads to safety concerns for personnel.

It is evident, however, that workplace health and safety is NID Hydro's top priority, and its safety record speaks to that. However, consistent with prior years, NID Hydro personnel noted that although they possess knowledge and expertise in general industrial workplace safety, deep expertise on electrical safety is limited within the Department. This was a recurring theme in our interviews for 2021. In addition, NID Hydro believes its safety program could be further improved by having a dedicated safety coordinator focused on the industrial and electrical safety aspects of NID Hydro's operating environment.

Organizational Culture

NID Hydro possesses a strong culture of safety and compliance which continues to mature. In 2021, the organization continued to grow that culture but there is still more room for growth. NID Hydro focuses on correcting legacy "shortcut" and "tribal knowledge" behaviors. This is especially important as the organization faces an increasing regulatory burden from FERC and NERC, wildfire mitigation and vegetation management challenges, and emerging cyber security threats. The correct mindset, documentation, and procedures are especially important for NID Hydro as external threats and risks escalate. Diligent documentation and the adherence to well-designed procedures is especially important in an invasive regulatory environment. Of course, improvements in this area are dependent on having sufficient resources to execute the procedures and document the work.

Organizational Structure and Staffing

NID Hydro's Organizational Structure and Staffing stabilized during 2021. NID Hydro was able to recruit a Compliance Technician and promote a Compliance Technician to Compliance Analyst to manage the workload brought on by the Deer Creek project, FERC re-licensing, and NERC compliance program. However, the Hydro organization did lose a critical person that was a technical field resource for the NERC Standards and will lose its Dam Safety Engineer to retirement during the first half of 2022.

The Hydro Operations and Maintenance Departments have experienced significant growth in workforce with no associated increase in supervision. The nationally recognized Incident Command System (ICS) suggests between three to seven subordinates per supervisor. Five is often recommended as the optimal number. Without any intermediate supervisors, the Hydroelectric Maintenance Superintendent has direct supervision over eleven subordinates and the Hydroelectric Generation Superintendent has direct supervision over eight subordinates. NID Hydro should reevaluate supervision requirements to ensure adequate oversight of staff is maintained.

Regulatory Environment

Regulatory risks facing NID Hydro continue to grow with FERC Dam Safety as a significant contributor to NID Hydro's current regulatory burden. The fallout from the February 2017 Oroville Emergency Spillway incident has greatly increased regulatory scrutiny and dramatically increased demands on NID Hydro. In addition, NID is struggling to keep up with the FERC relicensing process and all of the new conditions that come with it. This challenge is only exacerbated by the expected retirement of the Dam Safety Engineer in 2022.

Complying with regulatory requirements is mandatory and keeping up with changes, maintaining sufficient documentation, and responding to regulator inquiries demands significant attention and resources. Effective January 1, 2020, new, more onerous NERC CIP requirements also became enforceable. These new requirements involve technical cyber security controls that require constant attention and security expertise. Consequently, the risk of misstep poses operational, financial, and reputational risks to NID. In addition to the new CIP requirements, many of the new NERC Standards scheduled to be implemented and enforceable in 2020 were moved to 2021 due to COVID-19. These new Standards and the associated requirements are now enforceable.

In addition to FERC and NERC, NID Hydro is regulated by the California State Legislature, the California Energy Commission (CEC) (e.g., rules regarding how traditional hydroelectric power generation will be treated or viewed by load-serving entities and in the energy markets), the California and Federal Environmental Protection Agencies (EPA), the California and Federal Occupational Safety and Health Administration (OSHA), and various Resource Agencies, including the United States Forest Service (USFS), the U.S. Fish and Wildlife Service (USFWS), the California Department of Fish and Wildlife (CDFW), the California State Water Resources Control Board (SWRCB), and the National Marine Fisheries Service (NMFS). Specifically, in 2021 and present, NID is experiencing a dramatically increased workload due to SWRCB curtailments and data requests, an aging infrastructure that requires significant work and maintenance in the Tahoe National Forest and in or nearby waterways through NID's system, and the Deer Creek Project transfer from PG&E to NID. In addition, CAISO is placing more requirements on generation resources in its Balancing Authority Area. These increased requirements include generator modeling, RIG frequency response, and more involved interconnection, metering, and telemetry processes. These burdens affect both NID compliance and maintenance staff resources.

All forms of regulatory compliance place a heavy burden on NID Hydro and stretches its resources thin. The organization can expect the burden to increase in the years ahead. Maintaining compliance requires the organization's full attention, as well as a system of documented processes, procedures, and internal controls. Most importantly, the regulatory burden requires NID Hydro to build and sustain a culture of compliance lived daily by its people. The organization leverages this annual risk assessment to inventory and assess the organization's regulatory compliance burden and assess whether sufficient resources exist to meet that burden. Based on this risk assessment, GridSME believes that NID Hydro's resource capacity to meet the organization's regulatory compliance burden is not sufficient due to five primary drivers. These five drivers are:

1. Increased FERC oversight and scrutiny;
2. Resource Agency oversight and scrutiny (e.g., USFS, USFWS, CDFW, SWRCB, NMFS);
3. A growing infrastructure footprint (addressed in the Infrastructure and Technology section below);
4. A growing facility footprint (addressed in the Infrastructure and Project Planning sections below); and
5. An evolving CAISO and NERC compliance burden, specifically related to CIP cyber security control requirements.

FERC Regulatory Compliance

Perhaps the biggest regulatory risk facing NID today includes decisions or initiatives at FERC, such as reliability, security initiatives, dam safety, environmental, compliance, and re-licensing. FERC scrutiny and oversight dramatically increased beginning in 2017. At nearly the same time as the Oroville Dam spillway failure in February 2017, FERC's scrutiny of NID Hydro's activities began to increase. FERC reacted in an extreme manner and now requires NID Hydro to notify the Commission before performing a maintenance event, no matter the nature of the activity. In the past, NID Hydro would identify a maintenance need and address the issue, as soon as possible. Now, NID Hydro must notify FERC, and allow FERC to review and ask questions during a 60-day review window. This not only slows down reaction time to operations and maintenance needs, but it also consumes administrative resources and requires those resources to react very quickly to minimize FERC review delays. Given the increased FERC scrutiny, record-keeping and document retention are more important than ever before.

NID is also re-licensing the Yuba-Bear project that encompasses Chicago Park, Dutch Flat, Bowman, and Rollins. License issuance triggers a relatively quick timeline to perform necessary studies to complete the licensing process. In its current state, NID does not have the staffing levels required to handle this effort. It is estimated that one-to-two new compliance staff and one-to-two new maintenance staff would be needed to complete the re-licensing of the project. This is a risk that should be mitigated and planned for ahead of the process.

Another issue of concern is the acquisition of the Deer Creek powerhouse unit, as well as the addition of the South Yuba Canal from PG&E, which is the gateway to NID hydro's generation and water system. The Deer Creek transfer was approved by FERC on November 18, 2021. The facility will be absorbed by the Department in 2022.

The culmination of regulatory reaction and a growing and aging infrastructure has placed a significant strain on NID Hydro operations, maintenance, and compliance resources to keep-up with regulator demands and increased project workload. NID Hydro lacks depth and bench strength behind its Senior Engineer of Dam Safety who will be retiring in April 2022. Having sufficient resources in this area is especially important as NID continues its FERC relicensing efforts.

NERC Regulatory Compliance

Compliance and reliability risks associated with the NERC Reliability Standards, the Western Electricity Coordinating Council (WECC) Regional Standards, and their collective enforcement has the full attention of NID Hydro. To address its NERC obligations, NID Hydro’s Internal Compliance Program (ICP) directs the organization to perform a risk assessment annually. NERC and WECC are very focused on identifying and reducing risks to the Bulk Electric System (BES) and recommend that registered entities conduct regular risk assessments.

As the power grid evolves (e.g., increased intermittent renewable generation, the proliferation of storage, the retirement of many conventional generators, changing distribution system characteristics, ever-increasing cyber threats), NERC and the Regional Entities (e.g., WECC) are working diligently to keep pace. This results in an ever-changing set of Reliability Standards constantly in-flux. NID Hydro’s registration as a Generator Owner (GO) and Generator Operator (GOP) makes applicable and enforceable 316 Reliability Standard requirements and sub-requirements.¹ That presents 316 opportunities to “trip-up” and experience a compliance event, such as a compliance exception or compliance violation.

Complying with the currently enforceable Standards and Requirements is a significant undertaking. Adding to that burden are changes to the Reliability Standards and associated Requirements. Table 1 and Figure 1 below depict the total number of changes since NID Hydro’s registration with NERC in 2014. From NID’s registration until now, there have been 1,224 cumulative changes to the Requirements applicable to NID Hydro’s GO and GOP functional registrations. Years ago, NERC began talking about achieving a “steady state” with the Reliability Standards. As seen in Table 1 below, the Standards were hardly in a steady state until 2018 when activity did, at least temporarily, slow. 2018 saw a dramatic decrease in the number of Standard changes compared to prior years. However, activity picked up again in 2019 and 2021, and more changes are expected in 2022 and beyond.

	2014	2015	2016	2017	2018	2019	2020	2021	2022 Sched.
Requirements that became Enforceable	68	70	134	120	5	21	42	86	14
Requirements that became Inactive	114	99	222	118	27	47	41	44	21
Total Changes	182	169	356	238	32	68	83	130	35

¹ A NERC Reliability Standard contains one or more individual requirements and sub-requirements applicable to certain NERC functional registrations, such as a GO or GOP.

	2014	2015	2016	2017	2018	2019	2020	2021	2022 Sched.
Total Cumulative Changes	182	351	707	945	977	1,045	1,128	1,258	1,293

Table 1: NERC Reliability Standard Requirement Changes, GO & GOP

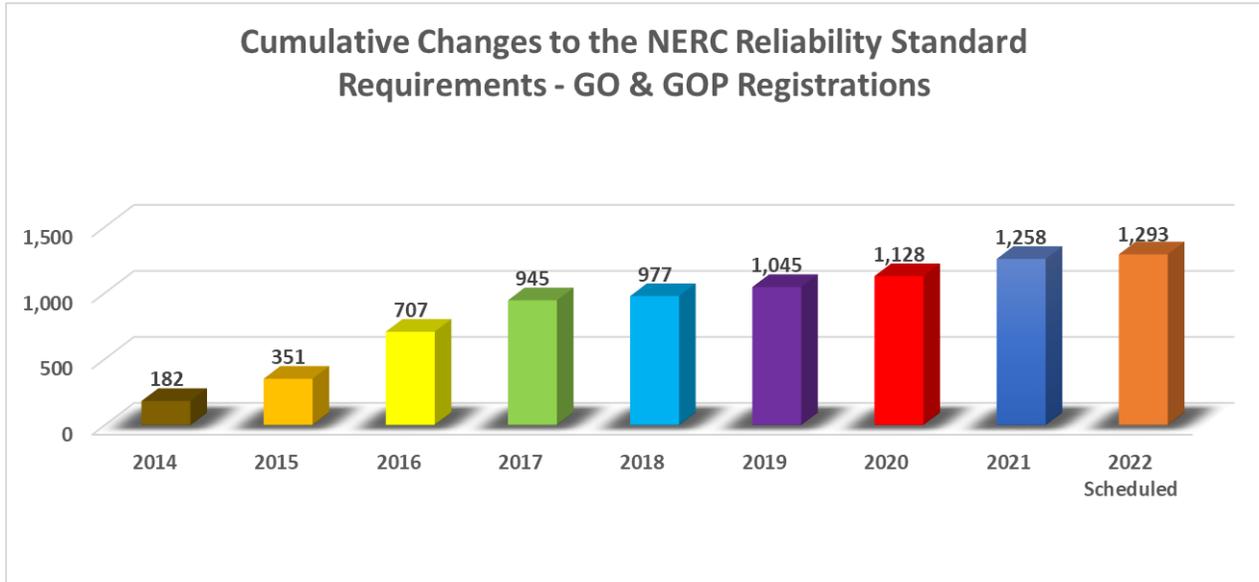


Figure 1: Cumulative Changes to NERC Reliability Standard Requirements²

Specific NERC regulatory risks identified and discussed during our risk assessment include:

- The volume and constant changes to the NERC Reliability Standard Requirements
- Rate-of-change of the NERC Reliability Standard Requirements
- NERC Standard revisions with short compliance windows (e.g., VAR-501-WECC-3 in 2017)
- Standard Requirements ambiguity and lack of clear guidance from NERC and WECC, in some cases
- PRC-004-6 Protection System Misoperation Identification and Correction: Revision of requirement R4 that required entities to perform investigative actions into Misoperations.
- PRC-027-1 Coordination of Protection Systems for Performance During Faults: new Standard requiring entities to perform a protection system coordination

² www.nerc.net/standardsreports/standarddetailexcellexport.aspx

study, communicate the study with the interconnecting utility, and create a method for how NID updates their protection settings.

- PER-006-1 Specific Training for Personnel: To ensure that personnel are trained on specific topics essential to reliability and to support Real-time operations of the Bulk Electric System.

Risk of Compliance Violations

A compliance violation often results in penalties that could, by law, exceed \$1 million per violation per day. In reality, actual penalties for compliance violations do not approach this level but are material, nonetheless. Table 2 below provides examples of penalties levied in 2021 by FERC, NERC, and the Regional Entities for violations of GO and GOP-applicable Reliability Standards.

Examples of NERC Penalties Levied in 2021³

Reliability Standard Violated	Reliability Standard Name	Nature of Violation	Penalty Amount
<p>FAC-009-1</p> <p>FAC-501-WECC-1</p> <p>PRC-005-6</p> <p>PRC-004-5(i)</p>	<p>Establish and Communicate Facility Ratings</p> <p>Transmission Maintenance (WECC)</p> <p>Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance</p> <p>Protection System Misoperation Identification and Correction</p>	<p>The RE had multiple violations of the four Standards listed. These violations included failure to include all of its current carrying series elements in its Facility Rating database, failure to inspect ten steel support towers, failure to use the correct internal Ohmic baselines values for station battery resistance testing, failure to maintain and test five Protection System relays within defined intervals at two BES substations, and a lack of sufficient controls to ensure its personnel evaluated Misoperations completely, using its Transmission Operations Tracking and Logging (TOTL) system.</p>	<p>\$2,200,000</p>

³ https://www.nerc.com/pa/comp/CE/Pages/Actions_2021/Enforcement-Actions-2021.aspx

Reliability Standard Violated	Reliability Standard Name	Nature of Violation	Penalty Amount
FAC-008-3 PRC-023-2 FAC-009-1	Facility Ratings Transmission Relay Loadability	The RE submitted self-reports related to a wide-spread issue with the accuracy of the RE's Facility Ratings across its Facility footprint, including several instances where the RE had incorrect transmission line Relay Trip Limits and a more limited issue related to incorrect bus equipment ratings at two generating sites.	\$570,000
VAR-002-3 VAR-002-4	Generator Operation for Maintaining Network Voltage Schedules	The RE did not maintain the generator voltage or Reactive Power schedule (within each generating Facility's capabilities) provided by the Transmission Operator (TOP). The cause of this violation was the lack of adequate procedural guidance for operators and adequate training on the requirements of VAR-002-4.	\$420,000
TOP-001-4	Transmission Operations		\$360,000
FAC-003-4	Vegetation Management	The RE did not identify a tree growing in close proximity to a 345 kV transmission line, resulting in a vegetation contact when the A phase conductor sagged into a 30-foot cedar tree. This vegetation contact tripped the line out of service for 4 hours and 30 minutes. The cause of this violation was ineffective vegetation inspections, and ineffective management and clearing activities.	\$300,000
FAC-008-3	Facility Ratings	The RE had multiple instances in which its field verifications	\$265,000

Reliability Standard Violated	Reliability Standard Name	Nature of Violation	Penalty Amount
		identified Facility Ratings that altered the Facility’s most limiting applicable Equipment Rating. The resulting Facility Ratings for its Facilities were inconsistent with its Facility Rating methodology.	
PRC-005-6	Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance	The RE discovered it did not verify that the communications system at one Bulk Electric System (BES) substation was functional every four calendar months, as prescribed within Table 1-2.	\$46,000
PRC-005-6	Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance	The RE submitted a self-report submitted a Self-Report to the Regional Entity stating that, as a Transmission Owner, it was in violation of PRC-005-6 R3. The RE concluded that there were 29 Protection Systems that were not compliant with PRC-005-6 R3 and required mitigation.	\$20,000

Table 2: Examples of 2021 Reliability Standard Violations and Penalties

Often, compliance violations cost far more than the amount of the NERC penalty. Violations also require entities to allocate considerable resources to report, negotiate, and mitigate the non-compliance event. Other indirect costs to compliance violations include reputational costs, increased regulatory scrutiny (e.g., more frequent spot checks and a shorter audit cycle), and a less forgiving regulator during future compliance events.

In 2021, NID did not experience any NERC self-reports or notice of potential violations. Looking ahead to 2022, the known key NERC compliance activities this year include:

- Annual review and sign-off of NID’s BES Cyber System identification review and CIP Senior Manager (CSM) approval completed on August 19, 2021
 - Completion must occur by November 19, 2022, but recommend performing by August 19, 2022

- CIP-003-8 (effective April 1, 2021) requires documented physical and cyber controls, including proactive management of Transient Cyber Assets (TCA) and Removeable Media (RM).
 - Ongoing monitoring and management of TCA/RM use is critical
- Respond to WECC's biennial self-certification request for COM-002, PRC-005, VAR-002-WECC-2, and VAR-501-WECC-3.1 for calendar year 2022
- Continued management and execution of the PRC-005 Protection System Maintenance Program
- Updating procedure and attestation documentation for scheduled Standard and requirement revisions
- Associated CFR Matrix updates, coordination, and execution with PG&E
- Compliance with CAISO generator modeling and data submittal requirements for NID's non-NERC jurisdiction but CAISO Tariff-enforceable
- Audit preparation including review of Department Procedures, Plans, and evidence in anticipation of WECC's 9-year audit interval cycle.

In addition to these activities that are known and predictable, there are many routine reporting and administrative activities that NID Hydro will continue to perform. It is likely that 2022 will also see regulatory inquiries and data requests, additional Reliability Standards changes, and O&M events that require compliance responses.

In particular, the increasing technical nature of CIP requirements on low impact BES Cyber Systems, which NID owns, requires diligent management and oversight. The low impact CIP requirements now include the continuous management of a TCA/RM program. What this means is each external Cyber Asset needs to be scanned and evaluated for the existence of malicious code before it can be connected to Chicago Park and Dutch Flat 2's BES Cyber Systems. In addition, the NID supervisory control and data acquisition (SCADA) system network firewalls should be monitored and periodically evaluated for vulnerabilities to ensure access is allowed and restricted in accordance with known and documented firewall rules. These activities are a continuous requirement NID must routinely perform to maintain compliance with CIP-003. The performance of the base CIP controls, as well as best practice industrial control system (ICS) cyber security controls that go beyond CIP requirements, are being evaluated by NID Hydro personnel.

The speed-of-change, the constant need to monitor NERC activity, and the importance of taking timely action culminate in a significant inherent risk to NID Hydro's compliance program. To address this ever-present risk, in 2014, NID Hydro implemented a formal Internal Compliance Program (ICP) carried-out by the Reliability Oversight Compliance Committee (ROCC) which meets quarterly to review recent NERC developments, review activities, and plan action items for the upcoming quarter(s).

NID Hydro's Hydroelectric Compliance Administrator left the District in early 2021. In response to this turnover, NID added a Hydroelectric Compliance Technician I and promoted the Hydroelectric Compliance Technician II to a Hydroelectric Compliance Analyst position in 2021.

The change of the resource makeup within the Hydro Compliance department has provided support in the absence of the Compliance Administrator. However, given the many compliance demands placed on the NID Hydro, outside resources are still needed to maintain the various compliance programs (e.g., NERC, FERC, etc.). Filling the Hydro Compliance Administrator position should be a top priority with the everchanging regulatory landscape and workload of the Department.

Looking forward, NID Hydro should expect and prepare to be audited by WECC in 2023. Given NID Hydro's registration in 2014 and that it has not undergone a formal WECC audit since registration, the possibility of an audit only increases year-by-year.

Operating Environment

While facing numerous and potentially significant inherent risks, NID Hydro continues to make a concerted effort to actively manage its risk profile. Organizations with strong risk management cultures and well-designed and implemented internal controls can effectively anticipate and mitigate risk. Given the size and complexity of NID Hydro's operations, the consequences of unmanaged risk can be catastrophic.

The annual risk assessment identified a variety of risks that reside within the Department's equipment and technology infrastructure and threats from external forces. To maintain the reliability of its aging infrastructure, NID Hydro implemented a Capital Improvement Plan in 2017 to strengthen the planning and capital budgeting process for major projects anticipated over the next 5 to 10 years. If not well-planned and executed, these projects have the potential to adversely impact NID Hydro's ability to meet its operating and financial objectives. By systematically and thoroughly planning projects, NID Hydro gives itself the opportunity to identify and mitigate project risks early. Long-term strategic planning also allows NID Hydro to respond to evolving risks throughout a project's lifecycle. The 2022 addition of the Deer Creek Powerhouse and associated South Yuba Canal adds another significant piece of infrastructure that must be maintained and operated.

The remote and rural nature of NID Hydro's operating environment presents many inherent risks. These include personnel safety, severe weather, the physical security of the infrastructure, wildfires, and vegetation management. This is made evident in extremely wet winter and spring storms as they take their toll on the terrain in and around NID Hydro's footprint. In addition, the growing cybersecurity threat to the U.S. power grid and those generators connected to it presents an ever-present risk to NID Hydro.

Wildfires and Vegetation Management

Although NID Hydro's infrastructure was fortunate to avoid wildfires in recent years, the risk of sustained damage from one or more wildfires is ever-increasing with each passing year. In addition, and as demonstrated by PG&E's equipment, perhaps the biggest risk is NID Hydro's equipment starting a wildfire. The wilderness surrounding NID Hydro's infrastructure poses two risk factors. The first is the ever-present wildfire risk during the annual dry season in the summer and fall. The second risk factor is vegetation management to both mitigate the risk of

igniting a wildfire and to minimize the impact to NID facilities if a wildfire occurs in the nearby area.

Vegetation management remains very important and very challenging. The interviewees identified this as an area of significant risk, but also an area where NID Hydro made even more headway in 2021. Heading into 2022, the Department has identified several critical vegetation management projects. The Department is diligent in identifying maintenance areas, sourcing vendors, managing the third-party coordination and approval process, and then completing the work. NID Hydro has performed vegetation management around and under powerlines and around powerhouses. Still, NID Hydro has substantial vegetation management work remaining to ensure the organization stays ahead of constantly emerging vegetation management risks. Another risk that has presented itself is a shortage of support from tree trimming companies and from companies that have the ability to haul out slash and timber from vegetation management clearing. Not surprisingly, PG&E has ramped up its efforts to clear vegetation away from power lines, which has caused contractor shortages in the broader area. This contractor shortage has increased contractor rates for labor and equipment, causing unfavorable actual versus budget variances for NID.

In addition, many of NID Hydro's projects reside on federal land, which creates unique challenges for maintaining the vegetation. To carry-out an effective vegetation management program and replicate the progress made in 2021, NID Hydro must navigate federal and state rules and regulations, as well as secure contractors that are in high demand. Some of its infrastructure resides on land owned by the Bureau of Land Management (BLM), and some owned by the Forest Service, including lands within the Tahoe National Forest. Both BLM and Forest Service approval and compliance is a continuous obstacle for NID Hydro and slow to overcome. Although obvious needs exist to proactively manage vegetation around its infrastructure, NID Hydro must be diligent about the process to gain timely approvals and cooperation from third parties. This creates just as much of an administrative burden for NID Hydro as it does a physical maintenance burden. Having sufficient workforce resources to timely identify, manage, and address vegetation risks is critical for NID Hydro.

The treacherous terrain and access barriers pose significant challenges to staying on top of NID Hydro's vegetation management efforts. Seasonal factors including weather, and biological migration and life cycles often limit when most vegetation management field activities can be performed, as well. The culmination of all factors requires prudent monitoring and management of the areas surrounding NID Hydro's infrastructure. Even with diligent vegetation management practices, it is almost inevitable that a wildfire will threaten NID Hydro's infrastructure. This was evident in 2021 when the River Fire burned 2,700 acres in close proximity to NID Hydro Headquarters, the town of Colfax, and NID facilities.

The River Fire and its impacts on NID Hydro's personnel safety and operations brought to light the need for continued reinforcement in training on the Incident Command System (ICS). All Department staff are trained in ICS 100 (Introduction to the Incident Command System). Supervisors are required to completed ICS 200 (ICS for Single Resources and Initial Action Incident). Designing, implementing, and training its people on an ICS can help NID Hydro

prepare for future wildfire incidents that impact operations. This will not only help ensure personnel safety and keep people out of harm's way, but it will also ensure a minimum level of business continuity for NID Hydro's operations.

During the River Fire the Hydroelectric Department Headquarter and District campgrounds at Rollins were in an Evacuation Warning zone and the homes of several Department members were as well. Highway 174 was closed and access to the area was extremely limited. PG&E struggled to maintain power in the area and relied heavily on the generation from the Rollins Powerhouse due to transmission issues associated with the fire. Department staff, with assistance from truck drivers in Grass Valley, were able to evacuate most trucks and expensive equipment from the headquarters in a matter of hours.

Extreme Weather Events

Like much of the power sector, NID and its personnel have witnessed first-hand extreme weather events become more common. Similar to the Texas cold weather event and power outages in February 2021, NID has also experienced the impact of extreme weather events and its adverse impact on the reliability of critical infrastructure facilities. NERC has responded to the February 2021 Texas events with new Reliability Standard requirements for Generator Owners, including NID, to implement cold weather preparedness plans.

In addition to the increased regulatory burden, NID's biggest challenge is maintaining the safety of its personnel and reliable operations of its facilities during these extreme weather events. In the past year alone, NID Hydro dealt with a number of extreme weather events, including the following:

- **Extended Drought:** Per NOAA, extreme wet weather in October and December 2021, much of California experienced the driest January to March on record. The dry end of the wet season leaves California and Nevada in a third straight drought year of drought with drought conditions worse in California than a year ago according to the U.S. Drought Monitor. Nevada intensified its drought, countering improvements made in late 2021. NID expects an early and active wildfire season with an increased risk of catastrophic fires. 2022's dry winter and spring may cause hydropower supply issues given reservoir levels and, for the California grid, an increasing reliance on electricity supplies (i.e., natural gas) that do not align with the state's greenhouse gas emission goals.
- **Bomb Cyclone (Oct-21):** In late October 2021, a series of three powerful cyclones brought high winds, historic rainfall, and heavy high-elevation snow to Western North America. The third cyclone in the series was the strongest of the storms and triggered a Category 5 Atmospheric River event. Many regions of the Northern Sierra Nevada range set 24-hour rainfall records and monthly precipitation total records for October.
- **Extreme Snow Storm and Extended Power Outage (Dec-21):** In December 2021, a series of snowstorms hit the Northern Sierra Nevada range and broke several monthly snowfall total records. The strongest of the storms dropped extreme snowfall on Nevada County on December 27th, including lower elevation areas that do not typically receive snowfall. 30,000 Nevada County residents lost power. NID Hydro's Colfax location was inaccessible

for part of the storm and the facilities were without power for several days. The storm adversely impacted the Department's operations for weeks as the area cleaned-up and recovered from the storms.

Undoubtedly, extreme weather events are becoming more common. We recommend NID increase its resource allocation toward planning for emergency operations and extreme weather events. This will likely entail the investment in additional equipment and emergency response and business continuity training for its personnel.

Physical Security

Given NID Hydro's remote infrastructure, it has experienced many threats to its physical security, and this is not likely to change. To address this risk, Hydro has taken many steps to improve the physical security of its infrastructure. This includes installing security cameras at Dutch Flat 2, Chicago Park, and Rollins in 2014, and Scotts Flat cameras prior to that, all new lock cores in 2016, and card readers in the powerhouses in 2019

Cyber Security

Cyber-attacks on public agencies, industrial control systems, and the power industry are becoming more prevalent. The power grid is now a prominent, high-value target. Whether it is enemy state and terrorist motivations, monetary gain (e.g., ransomware), or simply "because I can" motivations, cyber-attacks are a real and growing threat to the security of power grid operators and power generators. Examples of cyber-attacks in recent years include the Iranian "hactivist" group intruding a New York dam's SCADA system in 2013, the December 2015 hack of Ukraine's power grid which caused a major blackout, and the second, even more sophisticated December 2016 cyber-attack on Ukraine's power grid. In early 2020, a natural gas compressor station was the victim of a spear-phishing attack that spread from the organization's business network and compromised its control system impacting operations and causing significant financial damage. More recently at the end of 2020, a cyber-attack was detected involving Solar Winds' Orion Monitoring and Management Software commonly used across U.S. ICS and the power sector at large. This cyber event breached upwards of 250 U.S. Governmental Agencies. The attackers stole user data and highly classified information. Russian hackers appear to be the culprit of this attack. These threats have only increased with the current geopolitical unrest in Eastern Europe and Russia's February 2022 invasion of Ukraine.

Consistent with prior years' risk assessments, NID Hydro interviewees are very mindful of the cyber risks facing the industry and NID Hydro's infrastructure. Recent cyber-attacks on critical infrastructure throughout the world have made the risk very apparent. Nations hostile to the U.S. and independent malicious hackers are targeting the cyber assets that control electricity generation and power grid operations. The inoperability of NID's assets would result in downtime, lost revenue, increased operating expenses from the required response, and reputational damage. Hydro assets are certainly a target, not only because of their contributions to power grid operations and reliability, but also because of the magnitude of destruction possible if the assets were compromised and misused.

These cyber events hit home for NID in October of 2021 when the NID corporate network was compromised. An attempt to compromise NID's servers made it through the first layers of intrusion protection via NID's email server. As the malware moved through the network, NID's cyber defense controls activated and limited the cyber-attack's damage. No customer or staff information was compromised, and the Hydro division's infrastructure and network was not impacted as Hydro's SCADA network is isolated from the rest of the organization. Still, this cyber incident caused significant business interruptions throughout NID and the cost to respond and recover from the cyber-attack was significant. The event is certainly a forewarning of what the operational, monetary, and safety impact could be if such a cyber-attack were to hit the Hydro SCADA network.

NID Hydro's SCADA system presents inherent security risks to NID Hydro. The SCADA system also presents an opportunity to design and install effective internal controls that protect the assets from cyber threats. NID Hydro must continue developing and implementing new policies, processes, procedures, and controls that address certain key activities that are fundamental to securing the Department's critical infrastructure. These activities include:

1. Access management;
2. Change management;
3. Backup, incident response, and disaster recovery;
4. Network monitoring, logging, and review;
5. Patch management; and
6. Periodic cyber vulnerability assessments.

Performing these activities is especially challenging for NID given the limited resources within the Department and the NID organization. The activities listed above require resources that are familiar with the operational technology (OT) environment, a broad skillset and experience, discipline, and focus. Overall, as an organization, NID does not have the staff resources required to maintain a secure operating environment and hardened infrastructure. Currently, NID Hydro relies on the Grass Valley Information Technology (IT) department which itself is short on resources and unable to effectively support NID Hydro's business network, let alone the SCADA network. In addition, the IT department does not have experience with or an understanding of the SCADA system and the OT environment. The inability to effectively manage IT systems at NID Hydro can lead to cyber vulnerabilities, significant downtime and lost revenue, and non-compliance with NERC Standards, if unaddressed.

To ensure it has adequate and redundant staffing around SCADA system network management and cyber security, NID Hydro will need to recruit and hire personnel with this experience and skillset or outsource these functions. This is an area that NID Hydro should closely look at and evaluate the most cost-effective long-term solution to manage its SCADA system and protect its critical infrastructure. Given the complexity involved in managing IT systems in an OT or SCADA environment, it is highly recommended that NID Hydro hire one or more resources that sit and work out of the NID Hydro office in Colfax. Proximity to the people for collaboration, the powerhouses, and the SCADA systems is very important for this role.

Supply Chain Risks

In 2020, cyber security risks in the utility supply chain received increased focus and attention. On May 1, 2020, then President Trump signed an executive order (EO) halting the installation of bulk-power system (BPS) equipment "designed, developed, manufactured, or supplied, by persons owned by, controlled by, or subject to the jurisdiction or direction of a foreign adversary." The May 2020 Executive Order (#13920) declared, "threats by foreign adversaries to the security of the BPS constitute a national emergency." To address this threat, the order mandated that the Department of Energy (DOE) put forth guidance for the electric industry to mitigate this threat. On December 17, 2020, the DOE released the Prohibition Order (PO) Securing Critical Defense Facilities. The EO and PO intended to mitigate well known and long-standing cyber security supply chain risks. As seen with the 2020 Solar Winds security breach, cyber supply chain risks pose a real threat to the reliable operation of the U.S. power grid.

However, in January 2020, the EO was suspended by the Biden Administration, who instead requested the new DOE review the topic and provide recommendations on how to proceed. Despite the suspension and non-enforcement of the EO and PO, as a best practice, entities should prepare for increased scrutiny and supply chain requirements. The industry has been discussing how to address these risks since 2016 when FERC directed NERC to "develop a new supply chain risk management standard that addresses risks to information systems and related bulk electric system assets." Specifically, CIP low impact cyber supply chain requirements have been drafted and are going through the stakeholder comment process. To prepare for the increased regulatory requirements, as well as to mitigate cyber security risks, organizations like NID should perform an assessment of their cyber supply chain risks, procurement practices, and include country of origin in all cyber supply chain assessments and procurement activities.

Potential Impacts to NID and the NERC Reliability Standards

The current DOE has recommended that FERC, and consequently NERC, make additions to the existing version of CIP-013 and to include cyber supply chain requirements in the CIP low impact revisions being drafted. The current version of CIP-013 went into effect on October 1, 2020, but only applies to medium and high impact BES Cyber Systems, which means almost all generators, as well as the distribution system, are exempt from the Standard.

The updated guidance from FERC and NERC regarding supply chain risks does not affect NID directly other than it requires entities to avoid sourcing from specific enemy states. While CIP-013-1 is not currently enforceable on NID, NID Hydro should use the 2020 EO's updated guidance as motive to perform an overall assessment of its cyber security supply chain posture.

Two likely CIP low impact changes on the horizon will likely require NID to increase its cyber controls over its SCADA network. The first of those changes will be to implement a well-documented process for implementing electronic vendor remote access. For example, if OSI needs to access its SCADA system, NID has a formal, documented process in place to administer, monitor, and control that access. The second change will be to have network monitoring devices for its low impact BES Facilities. This will require a heightened level of security monitoring and logging for NID.

NID Actions to Address Cyber Security Risks

Cyber supply chain risks must be a consideration for any future procurement of electrical and programmable equipment. While evaluating NID Hydro’s supply chain risk is an important activity to perform, cyber supply chain risks should not be NID Hydro’s priority until it first implements and continuously monitors more foundational cyber security controls.

A framework for fundamental cyber security controls is the [Center for Internet Security \(CIS\) Top 20 Critical Security Controls \(CSC\)](#).⁴ This framework is a great starting point for an organization to evaluate the state of its cyber security posture. It is worth noting that cyber supply chain risk management controls are not present on the “Top 20 Critical Security Controls (CSC)” list. This is not to say that supply chain risk management is not extremely important for the reliable operation of critical infrastructure, just that there are many other fundamental controls that should be implemented first and foremost.

When NID Hydro is ready to turn its attention to supply chain cyber risk management, a few resources are listed below that offer guidance.

- [North American Transmission Forum \(NATF\) CIP-013-1 Implementation Guidance](#)⁵
- [Cyber Security Supply Chain Risk Management Plans Implementation Guidance for CIP-013-1](#)
- [NIST Best Practices in Cyber Supply Chain Risk Management](#)
- [DOE Cyber Security Procurement Language for Control Systems](#)
- [NERC FAQ Supply Chain – Small Group Advisory Sessions](#)
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Infrastructure and Technology

For multiple reasons, NID Hydro’s infrastructure and technology present high inherent risks. First, the age of the infrastructure requires constant maintenance. Because of this, NID has heightened its focus and efforts in several areas, including project planning, a computerized maintenance management system (CMMS), electrical documentation, spare parts, and its technology. The second driving risk factor is the 2022 addition of the Deer Creek Powerhouse (DCPH) Project and South Yuba Canal.

Aging Infrastructure

Although the industry has seen well-maintained hydro generation facilities perform reliably for nearly a century, NID Hydro’s infrastructure does present a significant risk for multiple reasons. First and most obvious, older equipment is more susceptible to reliability issues and require

⁴ <https://www.cisecurity.org/controls/>

⁵ <https://www.natf.net/docs/natf/documents/resources/supply-chain/natf-cip-013-1-implementation-guidance.pdf>

more frequent maintenance intervals. Second, drawings of older equipment are often inaccurate, which makes for difficult and time-consuming troubleshooting efforts. Third, the nature of the older equipment means troubleshooting is labor intensive, as compared to modern generation plants that are mostly digital. The culmination of these factors presents a major risk to NID Hydro's financial health should the availability and reliability of its equipment be compromised.

Consistent with prior years' risk assessments, interviewees expressed an appreciation for the organization's commitment to reinvesting in and maintaining its infrastructure. NID Hydro personnel greatly appreciate the organization continuously investing capital in infrastructure maintenance and improvement projects. There is concern, however, this year as the number of projects in the queue have outpaced resource availability for NID Hydro. There is a risk of these projects not being completed on time and on budget.

Project Planning

To keep pace with the aging infrastructure, maintaining NID Hydro's historical reliability levels requires constant investment, project planning, and execution. Absent a well-planned and executed maintenance program supported by a CMMS, the continued high availability of NID Hydro's generation assets is doubtful. The size of NID Hydro's infrastructure and the high volume of projects necessitates thorough and focused planning. NID Hydro's maintenance program has a risk assessment process fundamentally built into it. NID Hydro personnel are adept at identifying infrastructure risks and maintenance or replacement solutions to address those risks. Given the continuous high volume of projects on NID Hydro's docket, project planning must be thorough, focused, and well-orchestrated. To address this need, in 2017, NID Hydro transitioned away from an ad hoc planning process and instituted a formal planning process that considers input and risk assessments from maintenance and operations crews to support long-range project planning needs. NID Hydro refers to this as its Capital Improvement Plan.

The Capital Improvement Plan was implemented to proactively develop detailed and focused project plans. The process identifies the total life-cycle cost of each asset, and maps project schedules, staffing workload, and costs over the next 5 to 10 years. With this initiative, NID Hydro intends to increase the maturity of its project planning process so that projects are proactively identified and planned in detail. As part of the Capital Improvement Plan process, a review takes place at least annually prior to the annual NID Hydro budget season.

Electrical Documentation

Inadequate electrical system documentation remains a risk to NID Hydro's ability to maintain and troubleshoot its infrastructure. This risk is a function of the infrastructure's age as few as-built drawings were retained many decades ago, and what was retained is sometimes found to be inaccurate. In 2017, NID Hydro began taking steps to address this risk by hiring a contractor to review, validate, and update electrical documentation at the Bowman PH. In 2018, new electrical drawings were drafted for Chicago Park Powerhouse following the 2017 relay

replacement and upgrade. Electrical drawings were updated for Rollins Powerhouse in 2019 and Combie South in 2020. Drawing updates for Dutch Flat 2 were drafted in 2021 and are being verified in 2022. This risk deserves a continued focus and effort to further mitigate downside for the remainder of NID Hydro’s portfolio.

Spare Parts

In prior years, interviewees identified the availability of spare parts as a potential threat to the reliability of the hydro operations. Many system parts have long lead times and are high dollar items. These same parts, if they fail, present single-contingency risks that could leave NID Hydro’s major equipment inoperable for long periods of time. This problem is further complicated by the supply chain delays introduced by the COVID 19 pandemic. This makes spare parts inventory management a difficult and expensive proposition. Hydro is constantly faced with evaluating the cost-benefit trade-off of stocking expensive, long lead time spare parts. NID Hydro should continue to closely monitor the health and downside risk of its spare parts inventory. For example, NID Hydro does not have spare generator pole pieces for Dutch Flat or Chicago Park. These generators are set for rewinds and subsequent updates, but completion is a few years out. Failure of this magnitude is a major concern because it will result in a long-term outage of the powerhouse and substantial loss of revenue if the generators are not available.

NID Hydro follows the philosophy depicted in Table 3 below when making spare parts purchase decisions. However, due to budget constraints, there are times when a spare parts purchase in the “Long Lead Time” and “Expensive” category is not made. It is that category that poses the largest risk to NID Hydro asset availability long-term.

Spare Parts Inventory Decision Matrix	Lead Time	
	Short	Long
Inexpensive	Consider purchase	Purchase
Expensive	Do not purchase	Further analysis required

Table 3: Spare Parts Purchase Decision Matrix

Technology Changes: SCADA and CMMS Replacement

In 2017, NID Hydro began a complete replacement of its SCADA system, and the project was completed in 2019. This SCADA system upgrade reduces NID’s technology and operations risk but introduces new security risks, which is discussed further in the Operating Environment-Cyber Security subsection above.

NID Hydro’s computerized maintenance management system (CMMS), Lucity, identified as a risk in prior years, is inadequate for the needs of NID Hydro’s operations and maintenance

requirements. In July of 2019, the NID Board of Directors approved the purchase of a new CMMS called Sedaru. This upgrade is an important tool for documentation and record-keeping purposes, which has never been more important given the current FERC and NERC regulatory environments. The new CMMS provides increased functionality including unlimited data collection capability, database structure that limits asset data functionality, asset management tracking and reporting, full visibility of spare parts inventory, and purchase history, including vendor, date, and amount. The CMMS will be implemented in June of 2022.

NID Hydro does still lack a dedicated warehouse, which presents difficulty for personnel to manage inventory and mitigate single-contingency events. The Department has developed preliminary plans for a new headquarters building; however, preliminary cost estimates are high, and the feasibility of the facility is in question. The Department is exploring potential alternatives to address the situation.

NID Hydro Portfolio Growth

NID Hydro's footprint has increased in 2022 with the acquisition from PG&E of the Deer Creek powerhouse and South Yuba Canal. This acquisition is a strategic and critical project for NID. Owning these assets ensures NID remains in control of a critical conduit of the District's water supply. However, the acquisition will further stretch NID Hydro's existing resources and require NID Hydro to hire new positions.

In addition to the Deer Creek acquisition, NID Hydro has entered into an operations and maintenance agreement with South Sutter Water District to perform the maintenance on the Camp Far West powerhouse. Resource needs for this acquisition are yet to be fully determined and the District has included an exit strategy in the contract should they become too onerous.

In addition, NID continues to evaluate the possible construction of two new powerhouses. One at the Loma Rica Water Treatment Plant and a second powerhouse at the existing Rollins Dam. Very quickly, NID Hydro's portfolio could grow from 7 to 10 powerhouses. This growth will place new demands on all NID Hydro resources. Not only do more assets require additional regulatory compliance obligations (e.g., FERC, EIA, CPUC), it also requires additional obligations with the California Independent System Operator (CAISO). CAISO processes and requirements require attention and expertise and often must be addressed in tight compliance time periods. This CAISO burden only increases with each additional generation resource with very little scalability across the portfolio.

Colfax Hydro Headquarters

Given the growing infrastructure footprint, the ever-increasing need to maintain the aging infrastructure, and the heightened regulatory burden, NID Hydro's staffing and inventory needs are increasing. This has already manifested itself with the hiring of new positions in recent years and is likely to continue with the Deer Creek acquisition. The Colfax Hydro field office has run out of available space to house its growing workforce, tools, and equipment. In addition, NID Hydro lacks a formal and adequately sized warehouse. In 2018, NID Hydro located and acquired a site for a future NID Hydro field office building. Planning and design work for the new site

began in 2019 but the project was put on hold in 2021. This will become a pressing need for NID to address in the months and years ahead.

Electricity Revenue

General Electricity Wholesale Market Trends

PG&E's 2019 bankruptcy filing was a reminder of the importance of understanding and monitoring the CAISO wholesale electricity markets. Intermittent renewables (e.g., solar) continue to change the dynamics of the CAISO system. In 2020, wholesale energy prices remained relatively low for much of the year and the well-discussed "duck curve" shape of intraday prices continued to increase.

In the third quarter of 2020, CAISO did experience historically significant reliability risks and market volatility that many grid planning experts have been warning about for years. On Friday, August 14, 2020, CAISO issued a Stage 3 emergency, the first it had declared in 19 years. A Stage 3 emergency means CAISO had to drop firm load to avoid losing the system. This occurred during a significant heat wave that impacted much of the west. Throughout August and parts of September, CAISO issued a series of warnings and emergencies, and market prices reflected this uncertainty with extreme volatility and price spikes in the energy and ancillary service markets. These events are a reminder that California is pushing reliability limits as it transitions to renewable resources, while retiring, perhaps prematurely, conventional generation.

Intermittent renewable penetration, natural gas constraints, and conventional generation retirements will continue to increase the intraday volatility of wholesale electricity market prices. The installed cost of intermittent renewables, namely photovoltaic (PV) solar, and energy storage technologies, namely lithium-ion batteries, continue to decline as well. The abundance of solar PV in California suppresses midday wholesale electricity market prices many days of the year and drives down PPA prices across the country, particularly in California. PPA prices appear to have stabilized in 2021 and all-in bundled PPA prices may have finally bottomed out after a drastic decline over the past decade.

In addition to generally low but volatile wholesale electricity market prices, distributed generation (e.g., rooftop solar), behind-the-meter battery storage technologies, and the evolution of CCAs are reducing most utilities' (e.g., PG&E and municipal utilities) load profile. These factors are resulting in stagnant load growth, docile wholesale electricity market prices, localized over-generation situations, and an increase in generator curtailments. The culmination of these factors led to a very saturated and highly competitive electricity market in the latter part of the last decade.

However, as renewable mandates continue to increase, load-serving entities and CCAs are actively pursuing the procurement of carbon-free resources, including hydroelectric generation resources. Although average prices remain low, price volatility remains high. A favorable trend for flexible and dispatchable generation are higher ancillary service (A/S) prices (e.g., spinning reserves, regulation up, and regulation down). However, after very high A/S pricing in 2020, A/S pricing softened in 2021 as average spinning reserve, regulation up, and regulation down prices

fell by \$2/MW, \$4/MW, and \$1/MW, respectively, compared to 2020 average pricing. Although off-takers are eager to add resources to their portfolio that are renewable and carbon-free, as well as dispatchable and flexible, softening A/S prices as more and more battery energy storage system (BESS) resources come on the grid has dragged down market prices. Nonetheless, hydro resources with storage capacity and the ability to shape intraday production remain an ideal electricity resource for California's energy future.

Chicago Park and Dutch Flat #2 are both under long-term power contracts with PG&E with contract expiration approximately 11 years out. NID Hydro's smaller plants are entering new PPAs or will be in the next few years, and these electricity market forces will shape the future economics of those projects. Unlike Chicago Park and Dutch Flat #2, which are not under a volume-based PPA, many of NID Hydro's smaller run-of-river hydro generators will likely be under volume-based PPAs in the years ahead leaving the organization vulnerable to drought conditions and low market prices. This is important to note as Northern California experienced a historic and prolonged drought in the mid-2010s, followed by two near-record precipitation years, and now three straight years of drought conditions. It is evident that NID Hydro will not always be able to rely on snowpack for power generation. As the current power contracts begin to expire and NID Hydro re-contracts its power under market-driven and quantity-based structures (i.e., per MWh basis), drought conditions could pose a significant financial risk to NID Hydro.

To mitigate the impact of drought conditions and low market prices on NID Hydro's future electricity revenue, NID should continue to look ahead and evaluate how it can adapt to this changing environment. The evolving power grid dynamics incentivizes NID Hydro to consider operating its hydro resources under different operating profiles in the future, including a more flexible and dispatchable profile.

Figure 1 below presents 2021's average hour-by-hour CAISO day-ahead (DA), fifteen-minute market (FMM), and five-minute market (5MM) wholesale electricity prices in the Northern California area. As can be seen, the disparity between high and low prices continues to increase with the lowest pricing consistently experienced in the middle of the day (i.e., peak solar PV generation). Figure 2 shows energy and ancillary service prices by month in 2021, illustrating the increased value of electricity and availability during the late summer and early fall months, often months when NID runs low on fuel supply and begins to take fall outages. To California, the price volatility and seasonality are reminders of the need to reduce its dependency on gas and to develop a diversified portfolio of resources. These reliability and market price spike events do present an opportunity for hydro to increase its role and importance in California's energy portfolio. NID Hydro is contemplating how, and by how much, it can vary its generators' production and water flows intraday, provide ancillary services, and shift more generation and water flow into peak demand and price hours.

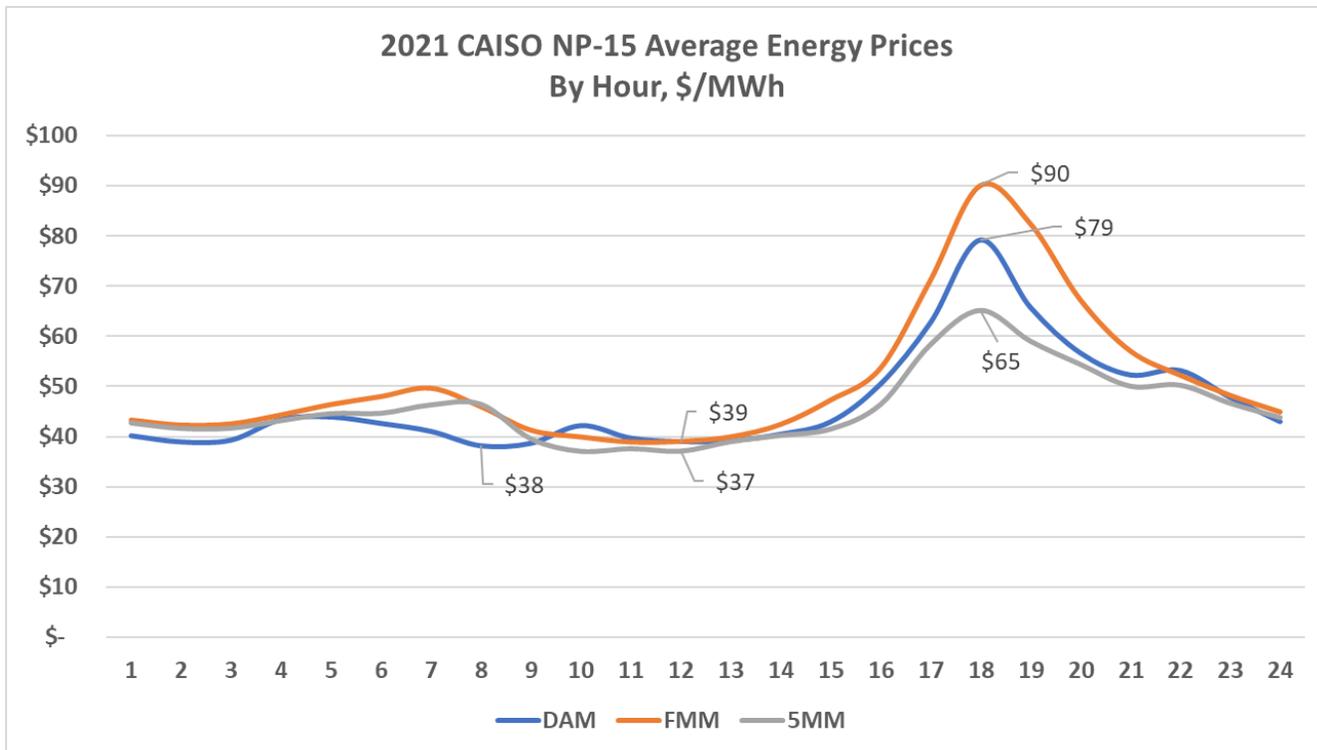


Figure 2: CAISO North Path 15 (NP-15) 2021 Average Electricity Prices by Hour

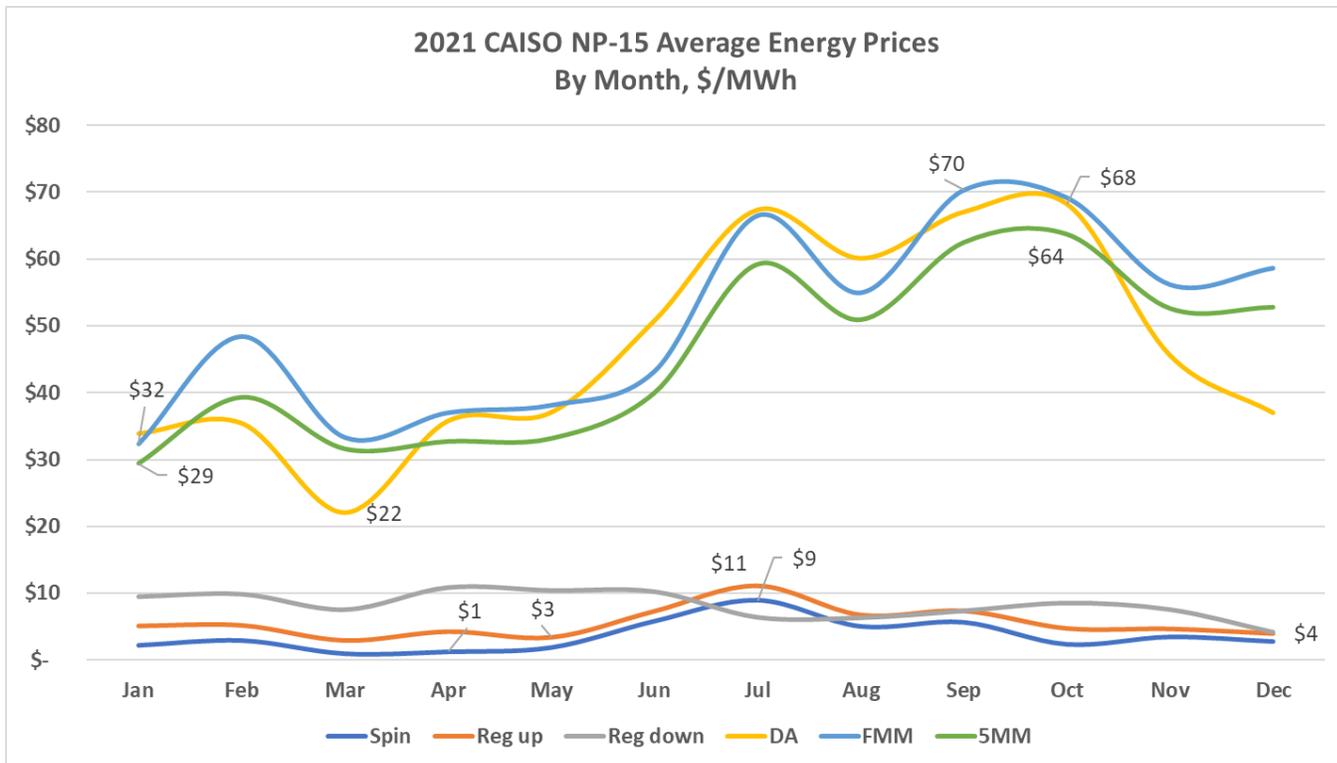


Figure 3: CAISO NP-15 2021 Average Electricity Prices by Month

Hydro generation has many advantages over traditional fossil fuel generation and intermittent renewable generation – the two technologies that shape wholesale market prices today. These advantages are presented in Table 4 below.

Criteria	Existing Hydro	Intermittent Renewables	Natural Gas
Capacity Factor	✓	X	✓+
Effective Load Carrying Capability (ELCC)	✓	X	✓+
Ability to Offer Ancillary Services	✓	X	✓
Dispatchable	✓	X	✓
Project Viability & Financing	✓	X	✓
Renewable	✓ ⁶	✓	X
Zero-GHG	✓	✓	X

Table 4: Hydro Advantages vs. Competing Generation Technologies

For these reasons, hydro is a good renewable and zero-carbon electricity supply partner to California’s municipal utilities and its growing population of CCAs. In 2021, NID Hydro was successful in re-contracting the Combie South Powerhouse. In early 2022, a new PPA for Deer Creek’s power sales has been approved and is nearing finalization and execution. These two agreements have formed a strong partnership between NCPA and NID, whereby NCPA provides Scheduling Coordinator and control center services for the Combie South and Deer Creek Powerhouses.

Internal Risk Control System – The Continuous Process

Risk management is a mixture of art and science. NID Hydro is making a concerted effort to implement a variety of policy and procedure-level controls throughout the department. This is evident with the ICP and ROCC activities performed by NID Hydro personnel, enhanced CIP policies and controls, as well as this annual risk assessment process. NID Hydro’s proactive efforts to implement cyber security policies and controls over its new SCADA system is also evidence of a maturing internal control environment.

⁶ Assuming RPS-eligible small hydro less than 30 MWs.

Recommendation and Conclusion

Based on the risks identified in the risk assessment tabletop exercise and summarized in this Risk Assessment report, a summary of the recommendations for risk mitigation are shown in Table 5.

To mitigate the impact and minimize the likelihood of the inherent risks facing NID Hydro, the organization should continue with its efforts to improve the maturity of its risk management program. Disciplined and strategic organizations take proactive steps to identify and manage risk. For example, strategic organizations often begin with the single-contingency risks that have potentially devastating impacts on the organization and develop control measures to mitigate those risks. Fundamental to this is a documented management system that enables the organization to identify, control, and monitor its risk elements. To do so effectively requires a systematic approach to catalog risks and the associated internal controls that actively manage those risks. Ideally, these internal controls reside at all levels of the organization. They are deployed not only as control activities by front line managers and personnel, but also as management control measures to monitor, communicate, and assess risks throughout the organization. The culmination of these risk management practices results in an organization with a strong control environment originating with a strong “tone at the top.”

Category	Ongoing Risk Reduction Measures	Key Recent Activities and Updates
People and Training	<ul style="list-style-type: none"> ▪ Support and promote external training opportunities for staff, although these options are currently limited due to COVID ▪ Internally develop and/or externally locate an alternative hydro operations training program, including more on-the-job training ▪ Continue research and development of a hydro maintenance training program, including more on-the-job training ▪ Coordinate asset management program needs with organizational structure and staffing needs. ▪ Continued focus on succession planning in all areas of NID Hydro ▪ Cyber security trainings held more frequent than required by NERC 	<ul style="list-style-type: none"> ▪ Union negotiations in 2021 led to market compensation adjustments for most personnel in the Hydroelectric Department with a few employee classifications with minimal salary increases. Also negotiated were incremental raises for cost of living. ▪ Multiple senior level staff were lost in 2021. Replacing those positions has been slow and is a top priority
Regulatory Environment	<ul style="list-style-type: none"> ▪ Continue growing staff competencies and bench strength 	<ul style="list-style-type: none"> ▪ Developed maintenance schedules for transformers and generators.

Category	Ongoing Risk Reduction Measures	Key Recent Activities and Updates
	<p>around regulatory compliance. Areas include reliability, NERC/FERC, dam safety, and environmental compliance.</p> <ul style="list-style-type: none"> ▪ Revise and update the CFR between NID and PG&E to appropriately allocate changing responsibilities. ▪ Scope, plan, and budget the FERC implementation compliance requirements. ▪ Continue diligent execution of NID’s PRC-005 Protection System Maintenance Program. ▪ Review and update of the Chicago Park and Dutch Flat #2 Facility Ratings (FAC-008) evidence 	<ul style="list-style-type: none"> ▪ Performed review and update to FAC-008 Engineering Documentation for CP and DF2 ▪ Implemented updated and expanded policies and plans for CIP-003 v8 ▪ Updated PRC-005 Protection System Maintenance Program documentation, including the Master Equipment List. ▪ Performed PRC-027 protection system coordination study for NID and PG&E interconnected facilities for increased reliability ▪ Generator testing completed for 5-year NERC compliance and CAISO modeling requirements at Rollins and Bowman Powerhouses ▪ Responded to FERC Additional Information Request associated with relicensing Completed FERC Part 12D inspections and associated reports at regulated dams ▪ Responded to curtailment orders issued by State Water Resources Control Board ▪ Substantially updated the EAP to address Cal OES comments, currently under review
<p>Operating Environment</p>	<ul style="list-style-type: none"> ▪ Continued investigation of NID’s non-dam infrastructure at-risk of extreme weather and/or seismic activity damage and incorporate mitigations and/or repairs into maintenance plan ▪ Continue vegetation management efforts around NID facilities. ▪ Evaluate adequacy of current resources dedicated to 	<ul style="list-style-type: none"> ▪ Implemented vegetation control adjacent to Infrastructure, where permitted, and continued navigating Federal permit processes for future vegetation control projects. ▪ Completed 5 year Arc Flash Hazard update studies. ▪ Implemented testing procedure for DC Lube Oil pump at Rollins in

Category	Ongoing Risk Reduction Measures	Key Recent Activities and Updates
	<p>management of Hydro’s current and future OT and SCADA system</p> <ul style="list-style-type: none"> ▪ Develop operational model to include regulatory and customer system requirements with operational strategy to support potential future energy market pricing opportunities and flexible dispatch contract requirements 	<p>response to insurance recommendations.</p>
<p>Infrastructure and Technology</p>	<ul style="list-style-type: none"> ▪ Capital Investment Program (CIP) – Continue to implement, evaluate and revise the CIP process to improve efficiency and effectiveness of major project execution ▪ Enhance asset management program risk assessment procedures to support project prioritization, planning, and budgeting. ▪ Incorporate methods of physical and cyber security hardening ▪ Implement plans identified in the communication infrastructure study to provide improved, efficient, and effective control and operations ▪ Continue efforts to improve and maintain a healthy inventory of spare parts ▪ Continue corrosion control monitoring of penstocks 	<ul style="list-style-type: none"> ▪ Installed new generator step up transformer at Combie South Powerhouse ▪ Replaced 60 kV oil circuit breaker at Rollins Powerhouse with vacuum circuit breaker. ▪ Installed balance of plant controller and vibration monitoring system at Rollins Powerhouse ▪ Installed cooling water flow monitoring and integrated into balance of plant PLC at Chicago Park ▪ Installed fire suppression system at Chicago Park Powerhouse ▪
<p>Electricity Revenue</p>	<ul style="list-style-type: none"> ▪ Research and develop power market optimization options for NID’s small plants to transition to upon current contracts’ expiration. ▪ Evaluate potential new technologies and/or strategies that allow more efficient operations in an evolving market 	<ul style="list-style-type: none"> ▪ Successfully transitioned Combie South Powerhouse to new Power Purchase Agreement ▪ Capital improvement projects to add metering and telemetry completed.

Category	Ongoing Risk Reduction Measures	Key Recent Activities and Updates
	and maximize hydropower’s positive impact to NID and the community. <ul style="list-style-type: none"> ▪ Coordinate energy marketing strategies with NID sustainability policy efforts. 	

Table 5: Summary of Risk Mitigations by Category

In accordance with the Nevada Irrigation District Internal Compliance Program, this 2021 Risk Assessment Report was commissioned by the Nevada Irrigation District Reliability Oversight Compliance Committee (ROCC), and its results shall be presented to the Nevada Irrigation District General Manager and Board of Directors.

Greg Jones, ROCC Managing Director of Compliance

Date