



# Staff Report

for the Regular Meeting of the Board of Directors, April 25, 2018

**TO:** Honorable Board of Directors

**FROM:** Keane Sommers, P.E., Hydroelectric Manager   
Jacqueline Longshore, Hydroelectric Compliance Administrator 

**DATE:** April 18, 2018

**SUBJECT:** Nevada Irrigation District Internal Compliance Program  
2017 Compliance Risk Assessment Summary Report (Consent)

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## *HYDROELECTRIC*

### **RECOMMENDATION:**

Receive and file the 2017 Risk Assessment Report prepared in accordance with the Nevada Irrigation District (NID) Internal Compliance Program as recommended by the Water and Hydroelectric Operations (WHO) Committee.

### **BACKGROUND:**

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 December 2017 and January 2018, 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:

- Equipment and Technology
- Regulatory Environment
- People and Training
- Electricity Market Landscape
- Operating Environment

Results were documented in a Risk Assessment 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 free from the risk to its organization, community, or BES that is evoked by the regulatory, staffing, equipment and external challenges identified in the 2017 Risk Assessment Report. With the key risk areas identified, NID will continue to move forward with risk prioritization, reduction, mitigation and elimination efforts.

Staff has presented the information at the Water and Hydroelectric Operation Committee prior to presenting it to the Board of Directors.

**BUDGETARY IMPACT:**

No budgetary impact.

KSS

JSL

Attachment:

NID 2017 Annual Risk Assessment

# NID 2017 Annual Risk Assessment

1/29/2018

Grid Subject Matter Experts

*This report presents the findings of the annual tabletop risk assessment exercise performed by key NID Electric Division personnel and GridSME*

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## Executive Summary

The Nevada Irrigation District (“NID” or the “District”) Electric Division faces a multitude of risks with the potential to, individually or collectively, threaten the ability to meet District objectives. This report identifies and assesses the most prominent risks, summarizes recent efforts to mitigate those risks, and offers recommendations on how to deploy an Internal Risk Control System (IRCS) to mitigate those risks.

Consistent with 2016 but with slight modifications, five risk categories were identified during the 2017 risk assessment. They are:

1. Equipment and Technology
2. Regulatory Environment
3. People and Training
4. Electricity Market Landscape
5. Operating Environment

Equipment and Technology risks are inherent to the nature of the work performed by the NID Electric Division and the associated facilities operated and maintained in serving out the NID mission. This category focuses on the Capital Improvement Plan, major projects, and growing staff.

Prominent Regulatory Environment risks include the North American Electric Reliability Corporation (NERC) Reliability Standards, the Federal Energy Regulatory Commission (FERC) Dam Safety and License regulations, and the associated rapid pace of change of regulations, mode of compliance, regulators, regulatory interpretations, and frequency of regulatory compliance monitoring. In addition, NID must face a variety of other regulatory risks including those of Cal-OSHA, Cal-EPA, and the state legislature. The sheer volume of regulations alone culminates into a significant burden on NID resources needed to monitor and stay apprised of the regulatory changes.

The risks within the People and Training category include talent recruitment, personnel training, a lack of bench strength in certain areas, and an aging workforce. During this 2017 Risk Assessment, the ability to train its less experienced employees was identified as the most critical risk to NID, and the recruitment of experienced qualified candidates a close second. If unmitigated, the combination of these two risks could materially impact the operating effectiveness of the District. Hiring, training, and retaining the right people are fundamental to managing all other risks.

The Electricity Market Landscape category discusses the risks facing NID in the states wholesale, renewable, and bi-lateral electricity supply markets. The state’s wholesale markets have become increasingly volatile with dramatic swings in intraday pricing, and frequent and routine negative price intervals (i.e., a generator must pay the market to deliver power). The state and the broader Western Interconnection’s generation capacity is abundant, but generator flexibility (i.e., the ability to deliver power during the daily net load “ramping” events) is at a premium. Most load-serving entities, including PG&E, have far exceeded the California Renewable Portfolio Standard requirements in the near-to-midterm, and demand is soft for renewable power. In addition, the state’s three large investor-owned utilities, and some municipalities, are losing customers to newly-formed Community Choice Aggregates (CCA). This has halted a considerable amount of long-term power procurement in the state. These factors mean that NID’s generators with expiring PPA’s in the next two to five years will face a very challenging market that places little value on “as-available” generation, but rather on generation that can shape its supply curve.

The Operating Environment category deals with other risks threatening NID's operations, infrastructure, and financial health, including threats to cyber security, the challenges faced implementing a computerized maintenance management system (CMMS), and physical threats to infrastructure – whether natural (e.g., wildfires) or malicious threats (e.g., break-ins and vandalism).

While faced with numerous and potentially significant inherent risks, NID is making 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 operations, financial, and compliance risks. As the size and complexity of NID's operating environment evolves, the consequences of unmanaged risk can have a significant impact on the District.

Failing to identify and manage such risks often prevent organizations from reaching their reliability and compliance objectives. The effective deployment of strong Internal Risk Control Systems (IRCS) and risk management tools help organizations identify latent organizational weaknesses, the potential for human behaviors to drift from expectations, and external risk factors. Risk management programs are the foundation to a secure business resiliency plan. This annual risk assessment represents one of many steps NID employs to maintain an effective IRCS and mitigate risk.

## Risk Assessment

In December 2017 and January 2018, GridSME met with several key NID Electric Division management and supervisory personnel to discuss and assess current and potential risk factors facing the NID Hydro operations. As part of this assessment, GridSME interviewed the Hydroelectric Manager, the Hydroelectric Program Analyst, the Senior Hydroelectric System Technician, the Hydroelectric Generation Superintendent, and the Maintenance Superintendent. This table-top risk assessment exercise identified five main risk categories facing NID:

- 1) Equipment and Technology;
- 2) Regulatory Environment;
- 3) People and Training;
- 4) Electricity Market Landscape; and
- 5) Operating Environment

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.

### Equipment and Technology

NID equipment and technology presents a high inherent risk due to the age of the infrastructure. Although the industry has seen well-maintained hydroelectric generation facilities perform reliably for nearly a century, NID's infrastructure does present a significant risk for multiple reasons. First and most obvious, older equipment is more susceptible to reliability issues, and requires more frequent maintenance intervals. Second, drawings of older equipment are often found to be 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's financial health as the



organization is highly dependent on the continued availability and reliability of its hydroelectric equipment.

Similar to the prior year's risk assessment, interviewees expressed an appreciation for NID's commitment to reinvesting in and maintaining its infrastructure. The Electric Division personnel greatly appreciate the organization continuously investing capital in infrastructure maintenance and improvement projects. When a proposed project demonstrates that the benefit exceeds the cost, project funding can be obtained.

Maintaining NID's historical reliability levels will require continued investments, and focused project planning and execution. Absent a well-planned and executed maintenance program, the continued high availability of NID's generation assets is doubtful. The size of NID's infrastructure and the high volume of projects necessitates thorough and focused planning. NID's maintenance program has a risk assessment process fundamentally built into it. NID personnel are adept at identifying infrastructure risks and maintenance or replacement solutions to address those risks. Given the large volume of projects on NID's docket, project planning must be thorough, focused, and well-orchestrated. To better address this risk, NID instituted a formal planning process called the Capital Improvement Plan (CIP) which will be further discussed in the Project Planning section below.

### Major Projects

2017 saw NID complete a full slate of maintenance and replacement projects. Two of the major projects completed in 2017 include the Chicago Park (CP) switchboard upgrades and Dutch Flat #2 (DF2) excitation system replacement. 2018 will be another active year, though it will not include major planned capital projects at CP and DF2, but rather a high number of small-to-medium size projects at the smaller, non-NERC-registered facilities.

Notable projects planned for 2018 include:

- Continue the installation of the software and hardware for the supervisory control and data acquisition (SCADA) upgrade project at the CP, DF2, and Rollins powerhouses.
- Install the new power system stabilizer (PSS) for at the Dutch Flat Powerhouse in the first quarter of 2018 (*in response to a new VAR-501-WECC-3.1 Requirement*)
- Continue hardening of critical infrastructure security by replacing old locks, adding key card readers, and improving cyber defenses
- Begin to implement the plans identified in the communications infrastructure study
- Install a fire suppression system in the CP powerhouse
- Install a programmable logic controller at the CP powerhouse
- Replace the existing fixed cone valve at the Rollins dam.
- Potentially complete the Deer Creek acquisition

Perhaps the most impactful project underway is the SCADA replacement project. A successful cut-over to the new OSI system is imperative, as is ensuring the proper security controls are in place to protect and manage the network.

### Vegetation Management

Vegetation management remains a very important, but a very challenging maintenance component. The interviewees identified this as an area where NID is not making as much progress as is necessary.

Diligent vegetation management requires a systematic and proactive approach to continuously identify maintenance areas, manage the third-party coordination, permit and approval process, and then schedule and perform the work. Examples of vegetation management needs include areas around and under transmission lines, penstocks, flumes, and canals. As many NID facilities reside on federal land, this creates unique challenges to maintaining the vegetation as NID must navigate cumbersome federal rules and regulations. Some of its infrastructure resides on land owned by the Bureau of Land Management (BLM), and some owned by the Forest Service. Both BLM and Forest Service approval and compliance is a continuous obstacle for NID, and slow to overcome. Although obvious needs exist to cut-back and more proactively manage vegetation around its infrastructure, NID 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 as it does a maintenance burden. Having sufficient workforce resources to identify, manage, and address vegetation risks is critical for NID.

### [Colfax Hydro Headquarters](#)

Given the growing infrastructure footprint, the ever-increasing need to maintain the aging infrastructure, and the heightened regulatory burden, NID's staffing 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 headquarters is quickly running out of available space to house its growing workforce, tools, and equipment. In addition, the Electric Division lacks formal and adequately-sized warehouse, meeting rooms, and offices. NID should begin planning for an expansion of the hydro headquarters in the next few years.

### [Project Planning](#)

The NID Electric Division began developing a Capital Improvement Plan process in 2017. The process identifies and maps-out the Electric Division major projects over the next 5 to 10 years. This is a big effort with the intention of increasing the level of effort around project planning so that projects are more proactively identified and planned in detail. As part of the Capital Improvement Plan process, a review will take place at least annually prior to the annual NID budget season.

### [Other Equipment and Technology Risk Factors](#)

#### [Electrical Documentation](#)

Inadequate electrical system documentation remains a risk to NID's ability to maintain and troubleshoot its infrastructure. This risk is a function of the infrastructure's age, as little as-built drawings were retained many decades ago. In 2017, NID began taking steps to address this risk by hiring a contractor to review, validate, and update electrical documentation at the Bowman Powerhouse. New electrical drawings are currently being drafted for CP following the recent relay replacement and upgrade. This risk certainly deserves a continued focus and effort to further mitigate the negative impact to the remainder of NID's portfolio.

#### [Spare Parts](#)

In prior years, interviewees identified the availability of spare parts as a potential threat to the reliability of the hydroelectric 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's major hydroelectric systems inoperable for long periods of time. This makes spare parts inventory management a difficult and expensive proposition. The Electric Division is constantly faced with evaluating the cost-benefit trade-off of stocking expensive, long lead time spare parts. In 2017, NID improved its risk profile in this



area by purchasing redundant protection relays for CP, and a backup exciter for CP and DF2. Still, interviewees noted that avoidable risks remain in this area, and NID should take a closer look at the health and risk of its spare parts inventory. For example, NID does not have backups for the Rollins protection relays, and should a device fail, the unit would be out-of-service until a replacement can be ordered and installed.

#### *Computerized Maintenance Management System*

The current NID CMMS, identified as a risk in prior years, is inadequate for the needs of the Electric Division operations and maintenance requirements. In 2017, the Electric Division began to implement the Lucity software purchased by the NID Water Department and found it to be lacking in several key areas necessary to meet the needs of the Electric Division. Given the age of the infrastructure, extensive maintenance activities, and high project volume, NID is considering the purchase and installation of a more robust CMMS.

NID is currently evaluating potential options to upgrade its CMMS. The potential vendors have been narrowed down to three potential solutions. This replacement and upgrade is likely to occur in late 2018. The upgrade of this system will be an important tool for documentation and record-keeping purposes, which has never been more important given the current FERC and NERC regulatory environments.

#### *Regulatory Environment*

Regulatory risk is the primary motivator for this risk assessment. In particular, compliance and reliability risks associated with the North American Electric Reliability Corporation (NERC) and the Western Electricity Coordinating Council (WECC) Reliability Standards, and their collective enforcement has the full attention of the Electric Division. Because of this, NID's Internal Compliance Program (ICP) directs NID to perform such 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.

While there are many additional regulatory risks facing NID beyond NERC and WECC, those regulatory risks are generally beyond the scope of this assessment. However, the impact of other regulatory risks is considered in this report because of the demand they place on NID resources. Such additional regulatory risks include decisions or initiatives at the Federal Energy Regulatory Commission (FERC) (e.g., reliability, security initiatives, dam safety, environmental, re-licensing), the California Legislature, California Public Utilities Commission (CPUC) and 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), and the Occupational Safety and Health Administration (OSHA), among others.

Specific regulatory risks identified and discussed during our assessment include:

- Increased FERC scrutiny, compliance, and re-licensing
- The ever-increasing burden of NERC Reliability Standard Requirements
- Rate-of-change of the NERC Reliability Standard Requirements
- NERC Reliability Standard revisions with only short compliance windows (e.g., VAR-501-WECC-3)

- Ambiguity of NERC Reliability Standard requirements and lack of clear guidance from NERC and WECC regulators
- Protection and Control Reliability Standard PRC-005: Reliability Standard revisions, performing timely maintenance to meet requirements, and generating required evidence of maintenance performed
- Critical Infrastructure Protection Reliability Standard CIP-003 for low impact BES Cyber Systems
- Management of the PG&E Coordinated Functional Registration (CFR) agreement
- Ambiguity and rate of change in CAISO's rules and processes

All forms of regulatory compliance place a heavy burden on NID and stretches its resources thin. NID 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 to build and sustain a culture of compliance lived daily by its people. NID leverages this annual risk assessment process to inventory and assess the organization's regulatory compliance burden, and whether sufficient resources exist to meet that burden. Based on this risk assessment, GridSME believes that NID's resource capacity to meet the organization's regulatory compliance burden is no longer sufficient due to three main factors.

These three factors include:

1. A growing infrastructure footprint;
2. Increased FERC scrutiny because of the Oroville Dam spillway event in the winter of 2017; and
3. An evolving NERC compliance burden.

#### Additions to the Infrastructure Portfolio

First, the NID footprint is expected to increase within the next few years with the acquisition of the Deer Creek Powerhouse from PG&E, and the possible construction of two new Powerhouses. In a short time period, the NID portfolio could increase from seven Powerhouses to 10. This growth will place new demands on all Electric Division resources. Not only will the additional assets increase the current regulatory compliance burden (e.g., FERC, EIA, CPUC), they will also require additional market compliance burden associated with installation, operation, and maintenance of California Independent System Operator (CAISO) certified generation meters. The CAISO processes associated with certified metering installation, operation, and maintenance requires significant time and attention to meet the stringent CAISO requirements and deadlines. This CAISO burden only increases with each additional generation resource with very little scalability across the portfolio.

#### FERC Regulatory Compliance

FERC scrutiny and oversight dramatically increased in 2017. At nearly the same time as the Oroville Dam spillway failure in February 2017, FERC's scrutiny of NID maintenance activities began to increase. Since the Oroville event, FERC has required that NID provide them notification before performing any maintenance, no matter the nature of the activity. In the past, NID would identify a maintenance need and address the issue as soon as possible. Now, NID must notify FERC and provide FERC time to review and comment before proceeding with completing the necessary maintenance. This not only slows down NID's ability to react in a timely manner to the operational and maintenance needs of its infrastructure, it also consumes administrative resources and requires those resources to rush solutions to

accommodate and minimize the FERC review delays. Given the increased FERC scrutiny, record-keeping and document retention are more important than ever before.

Specifically, FERC has focused much of its attention on potential spillway failure assessments. Since early 2017, six NID spillways have come under review, which requires significant attention from NID resources. The Scotts Flat spillway, in particular, requires major work, and NID resources have been allocated to that project. The culmination of a regulatory reaction and requirements, and an aging infrastructure has placed a significant strain on the Electric Division and administrative resources to keep-up with regulator demands and increased project workload.

### NERC Regulatory Compliance

The third factor straining NID resources is the growing NERC Reliability Standards compliance burden. As the power grid’s transformation evolves (e.g., increased intermittent renewable generation, changing distribution system characteristics, increasing cyber threats), NERC and the Regional Entities (e.g., WECC) work diligently to keep pace. This results in an ever-changing set of Reliability Standards constantly in-flux. NID’s registration as a Generator Owner (GO) and Generator Operator (GOP) currently subjects NID to 260 Reliability Standard Requirements and sub-Requirements.<sup>1</sup> That presents 260 opportunities to “trip-up” and experience a compliance event, such as a compliance exception or compliance violation.

The current compliance burden is only one part of the story. The amount of changes to the Reliability Standards and associated Requirements is the other part. The Standards are constantly in flux with the approval of new Standards and Requirements, and the revision or discontinuation of existing Standards and Requirements. The following table and graph depicts the total number of changes since the NERC registration of NID in 2014. Since that time, there have been 945 cumulative changes to Requirements applicable to NID’s GO and GOP functional registrations.

	2014	2015	2016	2017
Requirements that became Enforceable	68	70	134	120
Requirements that became Inactive	114	99	221	118
<b>Total Annual Changes</b>	<b>182</b>	<b>169</b>	<b>356</b>	<b>238</b>
<b>Total Cumulative Changes</b>	<b>182</b>	<b>351</b>	<b>707</b>	<b>945</b>

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

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<sup>1</sup> 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.

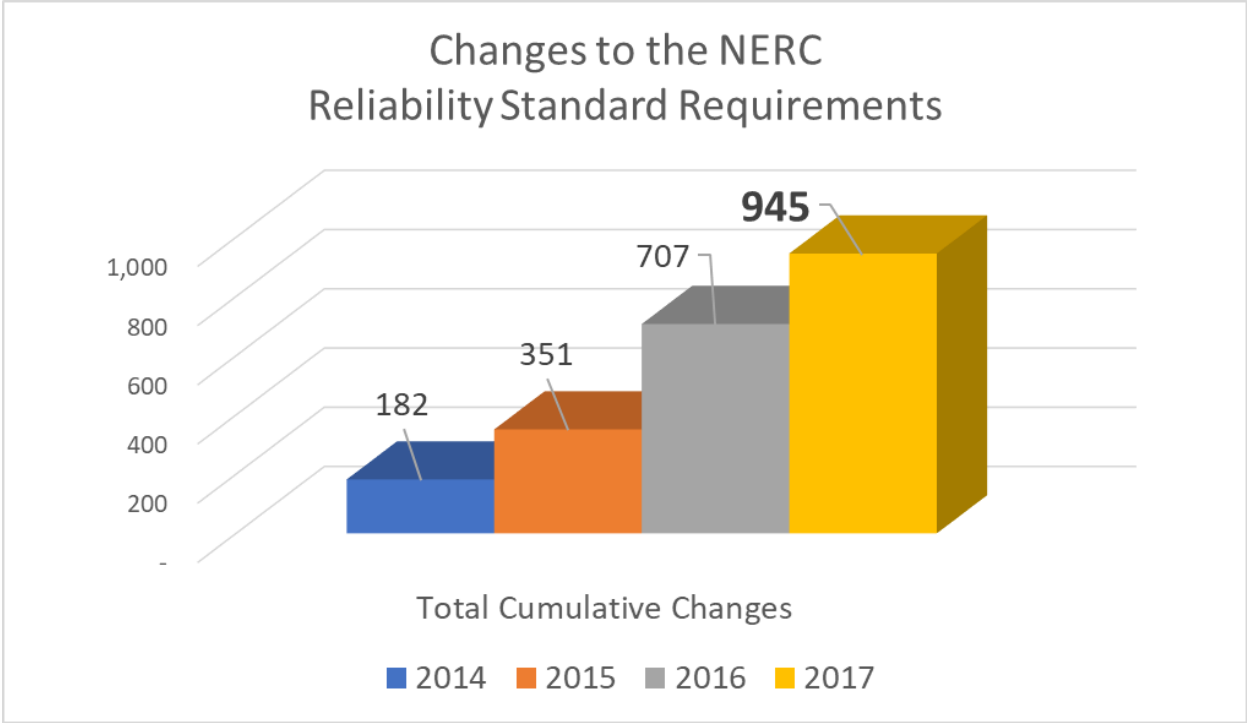


Figure 1: Cumulative Changes to NERC Reliability Standard Requirements

*Risk of Compliance Violations*

A compliance violation often results in penalties that could, by law, reach \$1 million per violation per day. Table 2 below provides examples of penalties levied in 2017 by FERC, NERC, and the Regional Entities for violations of GO and GOP-applicable Reliability Standards.

**Examples of 2017 NERC Penalties**

Reliability Standard Violated	Reliability Standard Name	Nature of Violation	Penalty Amount
<b>PRC-005</b>	Transmission and Generation Protection System Maintenance and Testing	The registered entity (RE) identified 192 devices, including relays, batteries, chargers and DC control circuits, for which maintenance and testing was not performed within the defined intervals in violation of PRC-005-1.1b	\$50,000
<b>FAC-003</b>	Vegetation Management	The RE identified a tree that had encroached the minimum vegetation clearing distance of a 230-kV transmission line causing an outage.	\$40,000
<b>PRC-005 VAR-002</b>	Transmission and Generation Protection System Maintenance and Testing And	Six violations occurred in large part due to historical weaknesses in internal controls related to Protection System maintenance and	\$100,000

	Generator Operation for Maintaining Network Voltage Schedules	testing as well as voltage regulation.	
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*Table 2: Examples of 2017 Reliability Standard Violations and Penalties*

Often, compliance violations are 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 September of 2017, NID experienced firsthand the impact of rapid regulatory changes and the significant Reliability Standard Requirement burden when NID submitted a compliance self-report to WECC for a possible violation of PRC-019. The PRC-019 NERC Reliability Standard required NID to verify, on or before July 1, 2017, that the Chicago Park (CP) and Dutch Flat 2 (DF2) in-service voltage regulators were not limited by the respective plants' protection systems. CP was verified without exception in 2016, and DF2 was coordinated and scheduled to undergo a similar verification exercise in April 2017. During the DF2 verification exercise in April 2017, NID was unable to verify full compliance with PRC-019 due to technological limitations of the infrastructure. Although it was not certain that DF2 was out of compliance (i.e., protection systems more limiting than the in-service limiters), the inability to verify full compliance with the PRC-019 Standard produced a possible non-compliance event. NID and GridSME consulted with WECC about the inability to verify and whether it should be reported. This communication to the Regional Entity also included the NID plan for replacement of the DF2 excitation system scheduled for Fall 2017, which would address the issue. WECC advised that NID self-report the PRC-019 issue. This is an example of the exorbitant burden of NERC compliance that is often unavoidable. In this case, NID was actively aware of a new upcoming compliance requirement, took the necessary steps to address the Requirement – which required complex and timely coordination internally and with external neighboring entities – but due to the technological limitations of the infrastructure, were unable to demonstrate compliance on the short timeline set by the regulatory entity.

A second example of the exorbitant burden potential of NERC compliance is the VAR-501-WECC-3 Standard that became effective on July 1, 2017. This Standard included a new Requirement that requires a GO who is replacing its excitation system, to also install a Power System Stabilizer (PSS) within 180 days of excitation system replacement. This Standard came into effect very quickly (approved by FERC just two months prior to the effective date), and required NID to immediately update its maintenance and capital investment plans to meet the short and stringent timeline to comply. These changes also necessitated the expenditure of a material amount of capital, and the additional manpower to schedule, plan, and coordinate an outage in the first quarter of 2018 to activate the PSS capability on the DF2 unit.

Critical NERC compliance activities in 2018 include:

- Executing a revised CFR with PG&E and maintaining a current version
- Development and implementation of an updated Cyber Security policies to meet additional physical and interactive remote access requirements of CIP-003 by September 1, 2018
- Continued management and execution of the PRC-005 Protection System Maintenance Program
- Re-verification of PRC-024 compliance for the new Chicago Park relays

- Installation of the Power System Stabilizer at DF2 in the first quarter in compliance with VAR-501-WECC-3

In addition to these activities that are currently known, there are many routine reporting and administrative activities that NID will need to perform. Further, it remains highly probable that 2018 will also see regulatory inquiries, Reliability Standards changes, and O&M events that require compliance responses.

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's compliance program. The District has 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 activities for the upcoming quarter(s). However, given the many other demands placed on NID resources, none of the ROCC members are able to dedicate significant time to NERC activities. Given the rapid change taking place in the industry, and therefore to the Reliability Standards, NID should consider adding resource(s) that would be able to dedicate significant attention to NERC compliance activities.

### People and Training

Our risk assessment process and the interviews of Electric Division staff identified several key risks facing NID'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, and personnel training.

### Workplace Safety

Considerable evidence exists to demonstrate that workplace safety is the District's top priority and receives the attention required. However, consistent with the prior year finding, NID personnel possess deep knowledge and competencies in general industrial workplace safety, but there is limited focus and expertise on electrical safety. NID's safety program could be further improved by having a dedicated safety coordinator focused on the industrial and electrical safety aspects of NID's operating environment. NID should consider bolstering its electrical safety program, and recruiting for a full-time safety coordinator. NID is currently pursuing an external broad industrial safety consultant who would have a considerable focus on electric operations, in addition to the water and recreation departments.

### Personnel Training

In 2017, NID continued to emphasize workforce training and development. It is clear the District sees a well-trained and prepared workforce as essential to maintaining its infrastructure and uninterrupted operations. NID also recognizes that a well-developed training program must contain both internal and external components. Both are essential. Internal training is necessary to prepare the workforce for the operating environment, activities, and scenarios unique to NID. External training is essential to gain exposure to proven industry best practices, external viewpoints, and new developments. But access to external training is becoming increasingly difficult for NID and other water agencies in Northern California.

### Operations

For its operations personnel, NID remains heavily dependent on PG&E's hydroelectric operations training program. NID has a long history of using PG&E's training program to qualify NID operators. This



training program has been extremely beneficial for NID and its personnel. Because of this, in 2016, NID cited the potential loss of an adequate training program as a major risk facing NID, and began taking long-term steps to mitigate this risk in 2017.

Absent access to PG&E's training program, NID would be forced to look for other hydroelectric training programs. Interviewees identified the closest equivalent training program to reside in Colorado, but the quality and the depth of the training is inferior to the PG&E training program. This is a single-contingency risk with considerable downside to NID.

Accordingly, the District began taking steps in 2017 to mitigate this risk with a contingency plan should it lose access to the PG&E hydroelectric operations training program. This is no small effort, and will take years to develop, but is an essential contingency plan should NID lose access to PG&E's operations training program. NID has also had preliminary discussions with neighboring water agencies (e.g., DWR, PCWA and YCWA) 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 it is clear NID must not rely on third-parties for its contingency plans.

#### *Maintenance*

Currently, the maintenance department (machinists and technicians) relies mostly on external training classes and vendor training offerings. In the prior year's risk assessment, it was noted that, unlike the operations staff, the maintenance department lacks a formal systematic training program, instead relying on a mostly ad hoc approach. In 2017, NID made a concerted effort to begin developing a structured and systematic training program for the machinists and technicians. This maintenance department training program will consist of both third-party and internally-provided training courses. This effort is well underway, and appropriately grounded first with the identification of each position's training requirements.

#### *Talent Recruitment and Retention*

Consistent with the 2016 risk assessment, talent recruitment and retention remains a significant risk to NID's continued success. Although employee turnover declined in 2017, fears remain that NID is in a weak position to retain and recruit outstanding talent. To make NID more competitive with the labor market, the NID Electric Division received a modest 2% market adjustment in 2017. Based on our review of market conditions, the Electric Division is still susceptible to employee turnover in the years to come if it remains below market averages. As noted in the prior year, it is believed the pay rates of nearby water agency hydroelectric divisions are 10% to 20% higher than the Electric Division's average pay rate. A market compensation survey is planned for 2018, and this is likely to be formally addressed by NID in the near future.

However, if unaddressed, the impact of lower pay rates will become more impactful as retirements increase, the workforce age and tenure decline. While personnel nearing retirement are disinclined to leave a job simply for better near-term pay, a younger, well-trained workforce will be far more prone to seek immediate pay raises simply by changing employer.

Currently, 32% of the NID Electric Division workforce is within five years of retirement age. High employee turnover has the potential to exacerbate other risk factors facing NID, and addressed within this report. These include employee safety, personnel training, equipment maintenance, and regulatory

compliance. Those risks become more difficult to manage, more present, and more impactful when organizations lack skilled, experienced, and well-trained people.

Facing the risk of high employee turnover, organizations should not only develop an employee retention strategy, but also institute succession planning. Faced with the real possibility of a material employee turnover in the coming years, The Electric Division should place more attention on succession planning at all levels. 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 (i.e., surprise departures with no backup).

As noted, NID plans to conduct a formal compensation review in 2018. This is an important and necessary step to mitigate the personnel turnover and recruiting risks facing NID. This assessment should look not only at the competitiveness of wages, but also at employee benefits, such as healthcare coverage.

Should NID experience increased turnover in the years ahead, which is likely given retirements, interviewees expressed a concern about the District's ability to find and recruit experienced and qualified staff. In our opinion, 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. In 2017, the NID Electric Division recruited for a journey level Communications Technician. No qualified candidates applied and the Department selected an entry level candidate requiring significant training.

### Succession Planning

The risk of turnover and challenging recruiting environment make succession planning a key initiative in maintaining an adequate workforce. The interviewees are all mindful of this need, and there are efforts being made to development the bench strength. As an example, the department practices back-filling and cross-training to cover vacations. The Electric Division is also looking ahead 5 to 10 years and identifying the personnel that will be able to step-up into more experienced and skilled rolls. This exercise also touches the training program development, which is a critical step in succession planning. To grow its bench strength, NID must know what skills they need at the next level, and the training and on-the-job experienced required to get there. It is important that the NID Electric Division employ such an iterative succession planning process.

### Organizational Culture

The Electric Division possesses a strong culture of compliance, and its self-identified "culture of compliance" continues to mature. Continued efforts were made in 2017 to build that culture, but there is still more room for growth. The Electric Division continues to focus on correcting legacy "shortcut" and "tribal knowledge" behaviors. These attitudes and compliance practices will be especially important for NID as the regulatory burden and cyber security risks continue escalating. The weakest area of the culture is perhaps in the documentation and procedure-based habits. Interviewees noted this is one area with considerable room for growth. Diligent documentation and the adherence to well-designed procedures is especially important in an invasive regulatory environment. Of course, improvements in this area are partially-dependent on having sufficient resources to execute the procedures and document the work. This is especially true in compliance-related areas.

## Organizational Structure

During the risk assessment, it was noted that turnover decreased significantly at all levels of the NID Electric Division. Unlike prior years, NID's Assistant General Manager (AGM) who started in 2017's first quarter, Finance Manager, Human Resources Manager, and Board Secretary remained unchanged during 2017. Although external to the Department, stability in District leadership is critical to the success of the Department. In addition, NID O&M personnel saw limited turnover in 2017. NID did hire new positions in 2017, but otherwise enjoyed continuity throughout the organization relative to prior years.

The Electric Division organizational structure was mostly unchanged in 2017, but did experience one minor change. Dam security now falls under the responsibility and oversight of the Hydroelectric Manager, and the AGM serves in an external review role and is briefed on dam security-related matters.

## Electricity Market Landscape

2017 saw a continued increase in the number of intermittent renewables on the power grid. This factor, as well as a record year for precipitation and snowfall in much of California, increased the volatility of wholesale electricity market prices. The installed cost of intermittent renewables, namely photovoltaic (PV) solar, and energy storage technology, namely lithium-ion batteries, continued to decline, as well. These two technologies are suppressing average wholesale market prices, and driving down power contract prices across the country, and particularly in California. However, imported solar PV panels were hit with a 30% Section 201 import tariff by the Trump Administration in January 2018. In the short-term, this could put upward pricing pressure on future power contracts by as much as 10%, but the magnitude and duration of this upward pressure is not expected to be material.<sup>2</sup>

In addition to falling wholesale electricity market prices, distributed generation (e.g., rooftop solar), behind-the-meter battery storage technologies, and the evolution of Community Choice Aggregates (CCA) are reducing most utilities' (e.g., PG&E and municipal utilities) load profile. These factors are resulting in shrinking loads, declining wholesale electricity market prices, localized over-generation situations, and an increase in generator curtailments. The culmination of these factors has led to a very saturated and highly-competitive market. Many power generators are eagerly searching for power off-takers (i.e., buyers) both in the long-term and the near-term. 2017 saw a record number of time intervals produce negative wholesale market prices for electricity.

Fortunately, CP, DF2, Rollins, and Bowman Powerhouses are under long-term power contracts with PG&E with contract expiration approximately 15 years out. NID's smaller plants do face expiring contracts in the next two to five years, and these electricity market forces will shape the future economics of those projects. These market forces have put downward pressure on the Electric Division's long-term revenue generation potential. These changing power grid dynamics could incentivize NID to operate some of its hydroelectric resources under different operating profiles in the future, including a more flexible and "dispatchable" profile. Figure 2 below presents 2017's average hour-by-hour wholesale electricity prices in CAISO's Northern California territory. As can be seen, the swings between high and low pricing has increased dramatically, and the lowest pricing is now consistently experienced during the middle hours of the day (i.e., peak solar PV generation). The figure also presents the average

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<sup>2</sup> Marathon Capital: Impact of Section 201 Import Tariffs on Utility-Scale Solar Levelized-Cost-of-Energy (LCOE)

day-ahead (DA), fifteen-minute market (FMM), and five-minute market (5MM) wholesale electricity prices for all hours of 2017. In short, NID should be contemplating how, and by how much, they could vary its generators' production intraday, and shift more generation into peak pricing hours.

## 2017 CAISO NP-15 Energy Prices By Hour, \$/MWh

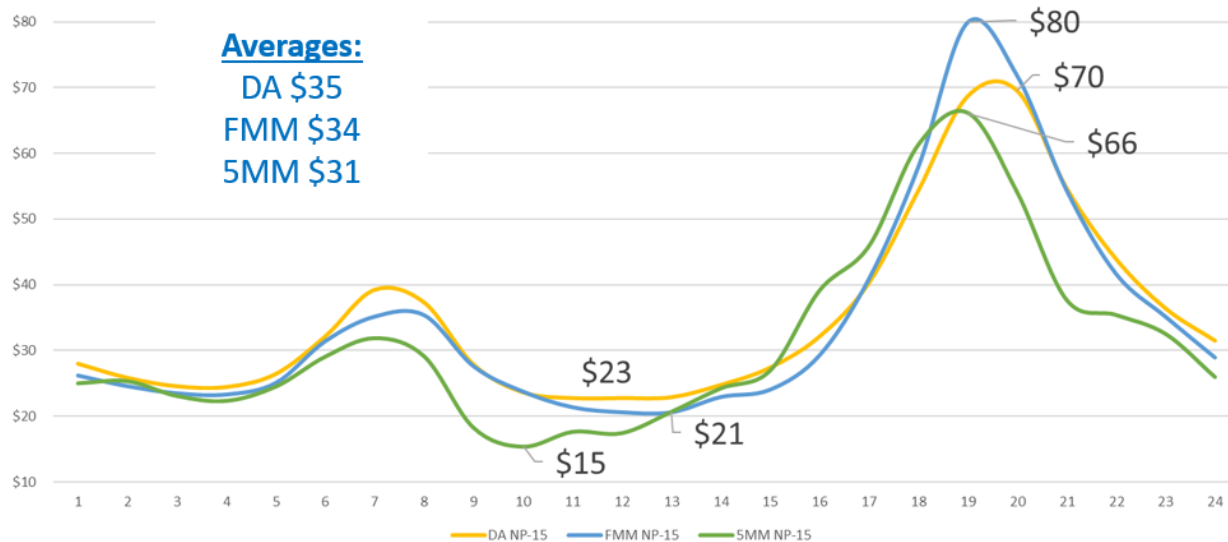


Figure 2: CAISO North Path 15 (NP-15) 2017 Average Electricity Prices by Hour

The good news is that hydroelectric generation does have many advantages over traditional fossil fuel generation and intermittent renewable generation – the two technologies that shape wholesale market prices. These advantages are presented in table 3 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	✓ <sup>3</sup>	✓	X
Zero GHG	✓	✓	X

Table 3: Hydro Advantages vs. Competing Generation Technologies

<sup>3</sup> Assuming small hydro less than 30 MW's.

For these reasons, hydroelectric should be a good renewable and zero-greenhouse gas (GHG) electricity supply partner to California's growing population of Community Choice Aggregators (CCAs). NID should begin taking steps to re-contract its generators with upcoming contract expirations, and consider the generators' ability to adapt to the changing landscape and operate under more variable generation profiles.

The current state and evolution of the electricity markets is important for another reason. This decade, Northern California has experienced a prolonged drought, as well as a record precipitation year. It is evident that NID will not always be able to rely on snow pack for power generation. Historically, drought conditions have had minimal financial impact on NID because of the structure of its power contracts. These power contracts incentivize and compensate generators based on availability, and cost recovery. However, as these power contracts approach their expiration and NID re-contracts its power under market-based and quantity-based structures (i.e., per MWh basis), drought conditions will pose a significant financial risk to NID.

### Operating Environment

The remote and rural nature of NID's operating environment presents many inherent risks. These include personnel safety, severe weather, physical security of the infrastructure, wildfires, and vegetation management. This was made evident in 2017 as an extremely wet winter and spring took its toll on the terrain in and around NID's footprint. In addition, the growing threat of cyber-attacks on the U.S. power grid and those generators connected to it presents an ever-present risk to NID.

### Personnel Safety

Several of the interviewees stressed personnel safety as the most important risk facing NID. Given the remote working environments, and unforeseen weather conditions common in the Western Sierras, constantly exposing personnel to these elements presents a significant risk. Because of this, NID operations and maintenance crews make a concerted effort to maintain preparedness for inclement weather, and take risk preventive measures, as appropriate.

### Severe Weather

Due to the exceptional precipitation that fell on Northern California in 2017, NID experienced very high flows in the upper elevations. This caused considerable damage to portions of NID property and the access infrastructure into NID property. One such example is the road into Rollins, which experienced a mudslide that required extensive cleanup. Some of the damage caused by these high flows were not repaired following the 2017 winter and runoff season. For example, the main route to the Bowman Powerhouse is still legally closed (NID does not own the road), and the Scotts Flat spillway will require significant repair following the high flow events. NID will need to not only repair damaged infrastructure where it can, NID will also need to be proactive in identifying infrastructure that is at-risk to extreme weather conditions and the impact those conditions can have on the terrain.

### Seismic Activity

Similar to severe weather conditions, seismic activity in NID's area is outside of the District's control, but can nonetheless be partially-mitigated with foresight and planning. One risk mentioned during the 2017 risk assessment is of a flume that appeared to have foundational problems – a condition likely created by weather and erosion, but a reminder that a major seismic event in the area could cripple certain critical parts of NID's system. Just as it should plan for severe weather and contemplate the impacts, NID

should also consider surveying its non-dam infrastructure, as well, to determine where it may be vulnerable to seismic activity and in need of repair.

### Physical Security

Given the Electric Division's remote infrastructure, it has experienced many threats to its physical security, and this is not likely to change. To address this risk, the Electric Division has taken many steps to improve the physical security of its infrastructure. This includes installing all new lock cores in 2016, a test of a card reader at one powerhouse and plans to install card readers in the powerhouses in 2017. Additionally NID has installed cameras at a number of facilities. Presently, physical security controls appear to be adequate.

### Wildfires and Vegetation Management

Although NID Hydro infrastructure was fortunate to avoid significant damage from wildfires in recent years, the risk of sustained damage from one or more wildfires is ever-increasing with each passing year. The wilderness surrounding NID's infrastructure poses two different risk factors. The first is the wildfire risk during the annual dry season in the summer and fall. Drought conditions only exacerbate this risk. In addition, the treacherous terrain and access barriers pose significant challenges to NID's vegetation management efforts. These risk factors require prudent vegetation management, as discussed previously, in the areas surrounding NID's infrastructure, but this is easier said than done. Even with diligent vegetation management practices intended for implementation by NID, the extensive regulatory permitting process and threat of wildfire originating from unmanaged wilderness adjacent to NID land and infrastructure remains a threat.

### Cyber Security

Cyber-attacks in the power industry and in the world economy are becoming more and more prevalent. The power grid is becoming a more prominent and higher value target. Whether motivated by an enemy state or terrorist ideology, monetary gain (i.e., ransomware), or simply "because I can", cyber-attacks are a real threat to the security of the power grid and generators. Examples of cyber-attacks that have occurred 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 more sophisticated December 2016 cyber-attack on Ukraine's power grid.

Consistent with prior years' risk assessments, NID interviewees are very mindful of the ever-increasing cyber risks facing the industry and NID's infrastructure. Recent cyber-attacks on critical infrastructure throughout the world have made the risk very apparent. There is no doubt that nations hostile to the U.S., and independent malicious hackers, are targeting the cyber assets that generate electricity and operate our power grid. Hydroelectric assets are certainly a target, not only because of their contributions to the reliability of the power grid, but also because of the magnitude of destruction possible if the assets were compromised and misused.

The Electric Division SCADA upgrade presents new security risks to NID. The upgrade also presents an opportunity to design and install effective internal controls that protect Electric Division assets from cyber threats. In effort to harden its cyber security position, NID has already begun taking steps to develop and implement new policies and procedures for access management and change management for the new SCADA system. In addition to sound access and change management controls, NID should



also consider developing and implementing network security controls, including, but not limited to, activity logging and review, patch management, and periodic cyber vulnerability assessments.

NID appears to have the appropriate cyber security expertise. However, the Electric Division alone lacks sufficient depth of cyber security expertise to maintain a hardened infrastructure. Currently, the Electric Division relies solely on the Grass Valley Information Technology (IT) Department which has limited staffing to fulfill cyber security across the entire District. This limited bench strength of the IT Department places NID at risk of a single contingency point-of-failure.

In addition to ensuring it has adequate and redundant staffing around SCADA system management and cyber security, NID will also need to establish roles and responsibilities. Currently, that responsibility resides with the Electric Division with support from the IT Department in Grass Valley. Traditionally in the electric utility industry, management of a SCADA system resides with the operating department. This is an area that NID should take a close look at, and evaluate whether the Electric Division has sufficient dedicated resources to manage its SCADA system.

## Internal Risk Control System

Risk management is a mixture of art and science. The NID Electric Division is making a concerted effort to implement a variety of policy and procedure-level controls throughout the Division. This is evident with the ICP and ROCC activities performed by NID personnel. The proactive effort in which NID is implementing cyber security policies and controls over its new SCADA system is also evidence of a maturing internal controls environment.

This Assessment is the first step toward formalizing the Electric Division approach to risk management. The Electric Division could improve the process by developing a formal, systematic approach to identifying and mitigating risk. One approach is to implement an IRCS process that documents risks, risk attributes, controls that mitigate those risks, and the control attributes, as well as scores of all elements based on certain qualitative factors. The process commonly used begins by first identifying and cataloging all risks. Next, the risks are assigned qualitative factors that are translated into quantitative measurements to assess the likelihood and impact of each risk. Based on the likelihood and impact criteria, risks can be scored and ranked to identify the highest risks threatening an organization. Next, current control measures in place to mitigate those risks are cataloged and associated with the risks. The organization may also make the effort to evaluate the design and effectiveness of the controls. The residual risk (uncontrolled risk) is then assessed and documented. From there, an organization can make professional judgments and perform cost-benefit analyses to determine the extent to which the risks should be controlled.

## Recommendation and Conclusion

To mitigate the impact and minimize the likelihood of the inherent risks facing the NID Electric Division, the Division should continue to improve the maturity of its risk management program. Based on the risks identified in the table top exercise and summarized in this Risk Assessment, a summary of the recommendations for risk mitigation are shown in Table 4.

Category	Recommended Risk Reduction Measures
<b>Equipment and Technology</b>	▪ Capital Investment Program (CIP) – Continue to implement, evaluate and revise the CIP process to

	<p>improve efficiency and effectiveness of major project execution</p> <ul style="list-style-type: none"> <li>▪ Implement the SCADA upgrade project and incorporate methods of physical and cyber security hardening into</li> <li>▪ Implement plans identified in the communication infrastructure study to provide improved, efficient and effective control and operations</li> <li>▪ Install a fire suppression system in the Chicago Park Powerhouse</li> <li>▪ Install a programmable logic controller at the Chicago Park Powerhouse</li> <li>▪ Continue the process of acquisition of the Deer Creek Powerhouse</li> <li>▪ Initiate a hydro headquarters expansion study to plan for growing staff numbers and need for additional space</li> <li>▪ Commission the revision and/or validation of electrical system documentation (e.g. as-built drawings) and implement electrical document change policy</li> <li>▪ Continue efforts to improve and maintain a healthy inventory of spare parts</li> <li>▪ Continue efforts to commission and deploy a CMMS</li> </ul>
<b>Regulatory Environment</b>	<ul style="list-style-type: none"> <li>▪ Increase staffing to support the increased demands associated with reliability, dam safety and environmental compliance</li> <li>▪ Install a Power System Stabilizer at Dutch Flat No. 2 Powerhouse</li> <li>▪ Replace the existing low level outlet valve at Rollins Dam</li> <li>▪ Revise and update the CFR between NID and PG&amp;E to appropriately allocate TOP-003 responsibilities</li> <li>▪ Implement vegetation control adjacent to Infrastructure, where permitted, and continue navigating Federal permit processes for future vegetation control projects</li> </ul>
<b>People and Training</b>	<ul style="list-style-type: none"> <li>▪ Pursue safety training consultant with considerable focus on hydroelectric operations</li> <li>▪ Support/promote external training opportunities for staff</li> <li>▪ Research and develop an alternative hydro operations training program</li> <li>▪ Continue research and development of a hydro maintenance training program</li> <li>▪ Support the formal compensation review and recommended wage and benefit adjustments</li> </ul>
<b>Electricity Market Landscape</b>	<ul style="list-style-type: none"> <li>▪ Research and develop power market optimization options for NID's small plants to transition to upon current contracts' expiration</li> </ul>

<b>Operating Environment</b>	<ul style="list-style-type: none"> <li>▪ Initiate identification 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</li> <li>▪ Continue vegetation management efforts around NID facilities</li> <li>▪ Evaluate adequacy of current resources dedicated to management of Hydro’s current and future IT and SCADA system</li> </ul>
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*Table 4: Risk Categories and Recommended Mitigation Measures*

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.”

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In accordance with the Nevada Irrigation District Internal Compliance Program, this 2017 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.

  
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 Greg Jones, ROCC Managing Director or Compliance

  
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 Date