Tab 4

Index

November 30, 2018

CENTRA GAS MANITOBA INC.

2019/20 GENERAL RATE APPLICATION

ASSET MANAGEMENT & NATURAL GAS CAPITAL EXPENDITURE FORECAST

INDEX

Appendices

CENTRA GAS MANITOBA INC.

2019/20 GENERAL RATE APPLICATION

ASSET MANAGEMENT & NATURAL GAS CAPITAL EXPENDITURE FORECAST

4.0 OVERVIEW

Tab 4 provides a summary of Centra's asset management framework and the resulting investments to maintain a safe and reliable natural gas system while considering economics and the environment.

Section 4.1 provides a summary of the Capital Expenditure & DSM Forecast (CEF18).

Section 4.2 describes the Centra's asset management framework, details of the current state of natural gas asset management, plans to improve the current asset management processes, and estimated timelines for the required work.

4.1 CAPITAL EXPENDITURE FORECAST

The Capital Expenditure Forecast ("CEF") is a projection of Centra's capital expenditures for new and replacement facilities to meet natural gas service requirements in the Province of Manitoba. The CEF also includes a projection of expenditures related to the Natural Gas Demand Side Management ("DSM") forecast.

CEF18 is the current capital expenditure forecast for Centra and is included in Appendix 4.1, along with copies of all approved capital expenditure forecasts since CEF13.

Centra's capital expenditures are classified as Business Operations Capital ("BOC"), which address requirements to sustain natural gas service through replacement of aging or obsolete assets as well as system expansion primarily related to customer connection requirements. The 10-year forecast for BOC takes into consideration Centra's capital investment requirements, associated risks, as well as current and future resource demands. The targets for 2018/19 and 2019/20 were developed

considering the need to balance operational priorities and optimize overall corporate value taking into account changes in business, financial and economic assumptions as well as operational risk factors.

In the short term capital expenditures are comprised of executing projects and programs. Projects are investments undertaken to add, replace and/or decommission an asset. The investment is planned on an individual basis with a defined beginning and end as well as a pre-defined scope, schedule and budget. Programs are a collection of similar investments that are managed in a coordinated way to obtain benefits which may not be achieved when managed individually.

The variance from target in the short term is recognition of year-to-year variations in the accumulation of program spending and recognition that external factors (contractor availability, procurement of property, external approvals, etc.) can affect project delivery and total spending in a particular year. In the longer term, the target variance includes investment requirements that are in the early stages of identification primarily through asset investment planning, condition-based replacements or planning studies. In addition, historic experience and extrapolation of trends are also considered.

Centra adopted the capital processes and approval levels implemented by Manitoba Hydro in March 2017 in support of the development of a Capital Portfolio Management Program. As part of this initiative the categorization of capital expenditures were changed from Domestic, Base and Major to the current categorization of Projects and Programs.

The Capital Investment Justification ("CIJ") document replaced the Capital Project Justification ("CPJ") document and is required for all new projects and programs as well as for program items within a program. This document seeks approval to proceed with the execution of an intended project, program or program item.

In addition, a new approval document, a Capital Investment Concept ("CIC"), was developed. The purpose of this document is to request funding to evaluate the need for a future investment and develop the associated scope, schedule and budget.

The document contains a high-level cost estimate of the conceptual project. Should the results of the scope development work support the requirement for a future project, a CIJ would be submitted for approval.

The approval documents are reviewed and authorized in accordance with corporate policy, the level of approval required increases with the estimated cost of the investment. The CEF is submitted annually to the Centra Board of Directors for review and approval.

Centra has also incorporated the use of investment categories into its Capital Expenditure Forecast, which are commonly used within the industry to provide stakeholders with a better understanding of the primary driver for the investments. The primary investment categories are further broken down into sub-categories. The primary investment categories utilized by Centra are Capacity & Growth and Sustainment. Capacity & Growth investments provide for system expansion or address existing capacity constraints. Sustainment investments are required to ensure the continued and future performance capability of the system and address the issue of aging or obsolete assets. Further information on investment categories can be found in Appendix 4.2.

In addition, DSM investments relate to programs that design, implement and deliver incentive based conservation programs to reduce natural gas consumption in Manitoba.

Figure 4.1 below provides a breakdown of Centra's Capital & DSM forecast by Investment Category for 2018/19 and 2019/20 and the 10 year forecast period included in CEF18, as well as a complete listing of all executing projects. A detailed description of all projects and programs are included in Appendix 6.1 of Tab 6.

Figure 4.1: Summary of Capital & DSM by Investment Category

($ Millions)	2018/19	2019/20	2018/19-2027/28 10 Year Total
Programs			
Capacity & Growth			
Customer Connections - Residential, Commercial & Industrial	15.7	18.5	196.0
Sustainment			
Mandated Compliance	6.1	7.3	77.5
System Renewal	5.7	5.8	62.7
System Efficiency	2.3	2.5	26.5
	14.1	**15.6**	**166.7**
Total Programs	**29.8**	**34.1**	**362.7**
Projects			
Capacity & Growth			
System Load Capacity			
Steinbach Natural Gas System Upgrade	0.4	1.4	4.1
Waverley West Upgrade	0.9	2.0	3.4
St-Pierre Transmission Pipeline Upgrade	0.4	-	0.4
Total Capacity & Growth	**1.7**	**3.4**	**7.9**
Sustainment			
Mandated Compliance			
Medium Pressure Monitoring System Replacement	1.2	0.7	1.9
Winnipeg Natural Gas Transmission Easement Widening	0.1	-	0.1
	1.3	0.7	2.0
System Renewal			
Brandon Primary Gate Station Re-Construction	1.9	1.2	3.1
System Efficiency			
Natural Gas Transmission Pipeline System In-Line Inspection	2.5	1.6	6.4
Letellier-Red River Transmission Upgrade	0.3	1.3	1.6
Provision of Secure Gas Supply-Portage	0.1	0.4	1.6
St. Andrews Distribution System Upgrade	1.2	-	1.2
Cathodic Protection Remote Monitoring	0.5	-	0.5
	4.6	3.4	11.3
Total Sustainment	**7.8**	**5.3**	**16.5**
Total Projects	**9.5**	**8.7**	**24.3**
Target Variance	(3.9)	(2.8)	16.9
Total Natural Gas Business Operations Capital	**35.4**	**40.1**	**403.9**
Demand Side Management	**9.4**	**10.8**	**103.7**
Total Natural Gas Capital & Demand Side Management	**44.8**	**50.9**	**507.6**

Natural gas capital expenditures included in CEF18 are comprised of investments related to the distribution system as well as corporate infrastructure whereas the expenditures included in the 2018-2023 Natural Gas Asset Management Capital Investment Plan in Appendix 4.3 are comprised solely of distribution system investments, resulting in a minor difference.

CEF Comparison

Over the 10 year period from 2018/19 to 2027/28 in CEF18, total forecasted expenditures are $49.5 million higher than the same period in CEF16, as shown in Figure 4.2.

Figure 4.2: CEF Comparison

	2018/19	2019/20	2018/19 - 2027/28 10 Year Total
Business Operations Capital			
CEF18	35.4	40.1	403.9
CEF16	32.4	29.2	352.1
Increase (Decrease)	3.0	10.9	51.8
Demand Side Management			
CEF18	9.4	10.8	103.7
CEF16	11.7	10.8	106.8
Increase (Decrease)	(2.3)	-	(2.3)
Total Change to CEF16	**0.7**	**10.9**	**49.5**

Over the 10 year forecast, Business Operations Capital requirements were increased by $51.8 million to align with the business priorities identified in the 2018-2023 Natural Gas Asset Management Capital Investment Plan as attached in Appendix 4.3. The investment plan includes projects such as Waverley West Upgrade and Brandon Primary Gate Station Re-Construction which were recently approved with expenditure requirements in 2018/19 and 2019/20.

The decrease of $2.3 million in DSM in 2018/19 was primarily due to a change in the mix of programs and updates to customer activity projections for the Load Displacement program.

4.2 ASSET MANAGEMENT

Centra is the single supplier of natural gas in the province of Manitoba. Centra's natural gas pipeline system supplies 280,000 customers through 10,329 km of pipeline and 400 pressure reducing stations. With installation starting in 1957, the

current system supplies all the natural gas in the province from Emerson in the south to as far north as Swan River. There are many stakeholders associated with the natural gas system; from customers and employees to the general public, contractors and regulatory authorities among others.

Centra's mandate is to maintain a safe and reliable natural gas system while considering economics and the environment. With portions of the pipeline system in excess of sixty years old, Centra must have plans to appropriately manage these aging assets while also considering the requirements for new customers, capacity increases and other system requirements. Centra has many inspection, survey and maintenance programs that assist in providing safe and reliable operation of the Manitoba gas system. Work has begun on defining assets, general asset conditions and identifying gaps in asset condition information.

Further work is needed to move towards an asset management plan that includes consideration of whole life costs of assets to assist in determining replacement requirements. This will help to define long term capital requirements while maintaining the safe and reliable operation of the natural gas system which is critical to Manitoba. The plans to improve the current asset management process, details of the current state of natural gas asset management, and estimated timelines for the required work are presented below.

4.2.1 Corporate Asset Management Initiatives Applicable to Centra

Manitoba Hydro's Corporate Asset Management initiative was launched in 2016 to foster mature and consistent asset management practices across the Corporation. The Corporation's asset management initiative consists of centralizing asset management governance and developing a Corporate Asset Management initiative to develop and implement mature and consistent asset management practices across the Corporation. The Centra natural gas system is within the scope of this initiative.

The Corporate Asset Management ("CAM") Governance Structure was instituted in 2016 to guide the development of an asset management system in support of Manitoba Hydro's strategic directives. It includes an Executive Council for

centralized vision and strategic direction; a Director-level Steering Committee to execute asset management development strategy; and Portfolio Managers responsible for developing & managing Corporate asset investment planning, evaluation, optimization, and approval processes and criteria.

Other CAM initiatives include the implementation of Copperleaf's C55 asset investment planning software to support the standardization of capital investment planning tools and processes, as well as the development of the Corporate Value Framework ("CVF") tool which supports value-based asset investment decision-making. Work is progressing to include all Centra programs and projects in C55 for evaluation.

Centra is committed to continually improving the way it manages its natural gas distribution assets and has established the following policy statements to guide the management of Centra's assets and the resulting investment plans:

- Develop, maintain and continuously improve asset management systems that:
  - Support and document an evidence based, risk-based and lifecycle approach to decision making;
  - Ensure employees have appropriate asset management competencies;
  - Are regularly reviewed and benchmarked appropriately; and
- Deliver system and asset class strategies and plans that support Manitoba Hydro's Mission and Strategic Priorities and are respectful of Manitoba Hydro's Principles, Corporate Policies and Mandated Compliance.

4.2.2 Maintenance Strategies

Asset maintenance and asset information are important components of an asset management program. A number of different maintenance strategies exist with different levels of sophistication, effort and cost. Different maintenance strategies may be appropriate for different assets based on the cost and risk of an asset failure. There are generally four strategies that can be applied towards asset maintenance, starting from the most basic form (Corrective Maintenance) and ranging to the most advanced (Reliability-Centered Maintenance), as outlined in Figure 4.3. Data requirements to support the use of each maintenance strategy are outlined in Figure

4.4. Maturing through each level involves increasing the organization's sophistication in being able to gather data to meet the key criteria identified for each level.

Figure 4.3: Maintenance Maturity

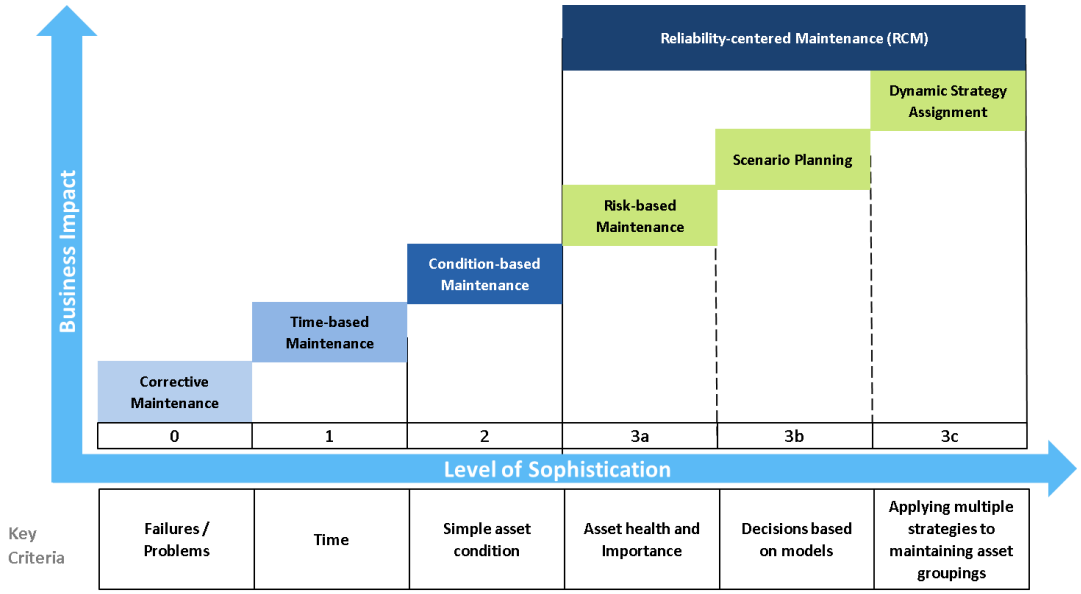


Figure 4.4: Data Requirements for Each Level of Asset Maintenance Maturity

Asset Management Maturity Level Data Requirements	Corrective Maintenance	Time-Base Maintenance	Condition-Base Maintenance	Reliability-Centered Maintenance (RCM)		
				Risk-Based Maintenance	Scenario Planning	Dynamic Strategy Assignment
Notification of failure	✓	✓	✓	✓	✓	✓
Unique identifier	✓	✓	✓	✓	✓	✓
GIS data	✓	✓	✓	✓	✓	✓
Expected end of life		✓	✓	✓	✓	✓
Asset Classes			✓	✓	✓	✓
Physical Properties			✓	✓	✓	✓
Maintenance Properties			✓	✓	✓	✓
Environmental Conditions			✓	✓	✓	✓
Asset Condition Assessment			✓	✓	✓	✓
Operational Properties				✓	✓	✓
Financial Data				✓	✓	✓
Legal Properties				✓	✓	✓
Stores Data				✓	✓	✓
Additional Financial Data					✓	✓
Additional Asset Condition Assessment					✓	✓

The asset maintenance strategies are discussed in the sections below.

Corrective Maintenance

Assets that have a Corrective Maintenance strategy applied are placed into service and are generally left untouched and unmonitored until they fail and a notification of the event is created. This strategy is well-suited to address equipment that has a low value to the business or is impractical or uneconomical to inspect.

Field crews are dispatched to replace the asset and restore service when failure occurs. Little effort and expense is put towards operational sustainment and/or life-extension practices.

Minimal data is required to make decisions under this strategy such as notification of failure, unique identifiers to specify the exact assets that have failed and Geographic Information System ("GIS") data to enable sending crews to the correct location of the replacement. Residential pressure regulators cost about $35 and the replacement of these regulators has been primarily been on a failure basis.

Time-based Maintenance

The first steps towards more matured maintenance approaches are taken when Corrective Maintenance strategies shift to Time-Based Maintenance strategies. The rationale for Time-Based Maintenance strategies is often driven by original equipment manufacturer ("OEM") recommendations for asset lifespans and optimizing on-shift operational resources. In following OEM recommendations, replacement of assets is performed within a reasonably controlled environment (i.e. non-overtime periods with notifications sent to customers); however, assets may be replaced that are still in good working condition. Under this strategy, little effort or expense is still put towards sustainment or life-extension practices.

Additional data is required to support the implementation of this strategy, specifically "expected end-of-life" ("EOL") data. EOL data is usually gathered from either the manufacturer or from industry best practices. Notification of failure data is still needed under this strategy in the event that assets need to be replaced prior to its expected EOL. Maintenance of system valves, odourizer equipment and a number of other pieces of mechanical equipment are maintained on a scheduled, time basis. At this time no equipment is replaced specifically based on a defined, expected life.

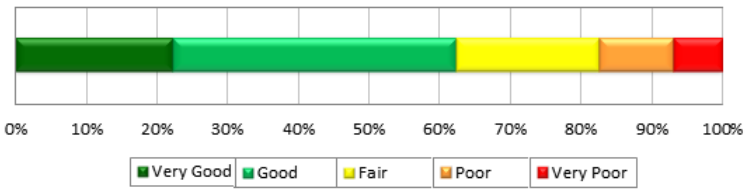
Condition-Based Maintenance

Condition-Based Maintenance is the strategy where intervention by the utility is determined by the equipment's current condition. Following this practice, much more effort and expense is invested in inspecting the state of individual assets in the

field. Based on the data collected, the condition of the asset is determined and a much clearer picture can be developed to determine whether the asset is approaching EOL. Staff replace the asset only if significant degradation of the asset is seen, indicating that asset failure is imminent (i.e. within a one year period).

In order to apply this practice, a significant pool of data is required. Information is primarily gathered from field inspections; however, it can also be gathered from incident logs and event notifications. Manufacturer defects and maintenance records are also taken into account. These data points are used to determine the Asset Health Index ("AHI"), a standardized scoring system that allows asset managers to quickly and effectively rank an asset's condition relative to its expected lifespan. Figure 4.5 provides an example of an AHI chart illustrating the complete life cycle of an asset (i.e. 0% represents brand new and 100% represents end of life) and each colour represents the condition of the asset as it progresses from cradle to grave. Station upgrades/replacements are performed based on an evaluation of the existing station condition.

Figure 4.5: Sample AHI Health Chart



<u>Reliability-Centered Maintenance ("RCM")</u>

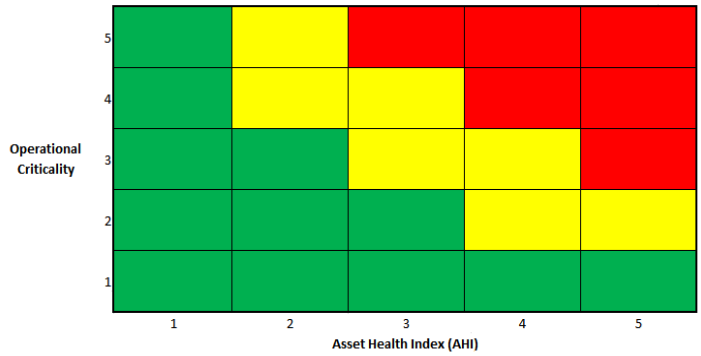
RCM is a practice used to ensure assets meet their expected performance levels using the most efficient level of resources. Successful implementation of RCM will lead to increases in cost-effectiveness and reliability, and a greater understanding of the level of risk the organization is managing. This overall strategy can be staged in three different levels of complexity, namely:

1. Risk-Based Maintenance;
2. Scenario Planning; and
3. Dynamic Strategy Assignment.

Risk-Based Maintenance

The first stage of RCM introduces the concept of risk management. Under this methodology, an asset's probability of failure is compared to its consequence of failure to determine the risk associated with the asset. The probability of failure is assumed to be EOL due to condition based on the asset's AHI. AHI is compared to an asset's criticality: a calculation that results in a standardized value ranking of an asset's importance to the continued operation of the natural gas system. The criticality value is calculated on a number of aspects including the role which the asset plays within the grid, replacement costs and societal costs. The asset's AHI and criticality values are plotted on a matrix in order to understand the risk associated with each asset. Only those assets that are identified as "High risk", as seen in red in Figure 4.6, are scheduled for replacement.

Figure 4.6: Risk Matrix



Maintenance Based on Scenario Planning

Scenario Planning represents the second stage of RCM, which introduces the use of forecasting in order to make better use of risk management practices. Under this methodology, decisions are based on evaluating the forecasted results of proposed changes to operational processes. In order to predict these outcomes, an in-depth understanding of business processes must be established. This is accomplished by accessing and applying additional asset data on top of what was collected under previous methodologies; the scope and amount of data to be collected is dependent on an understanding of the risks involved and/or the impacted business processes. This supplemental data is primarily based on financial reports and resource

availability. Once available, this information can support comprehensive risk-based decisions.

Maintenance Based on Dynamic Strategy Assignment

Dynamic Strategy Assignment represents the third stage of RCM by amalgamating the benefits of both risk management and forecasting to provide a more comprehensive picture of an individual asset's life cycle. As a result, it is the most advanced form of asset maintenance strategies. Decisions on how to maintain each asset is done by forecasting when those assets will reach their respective operational end of life with a high degree of confidence. Based on this, asset maintenance strategies can be modified regarding how to best manage the asset through either replacement or applying life extending practices. This will allow assets that represent the highest levels of risk to be addressed at the appropriate time, in the most cost-effective manner. In order to accomplish this, all relevant data associated with the asset, from physical properties, to environmental conditions, to replacement costs, to operational and maintenance logs are needed to build a complete asset life cycle model.

4.2.3 Natural Gas Maintenance Strategies – Present

Centra has many programs in place to provide inspection and maintenance of the natural gas system, as shown in Figure 4.7 below. Information gathered from inspection and survey programs are used to support a Condition-Based Maintenance strategy (examples would include depth of cover surveys, leak surveys, and station inspections among others).

Figure 4.7: Inspection & Maintenance Programs of the Natural Gas System

1. Cathodic Protection System Monitoring
2. Close Interval Potential Survey
3. Coating Shielding Corrosion
4. External Corrosion Direct Assessment
5. Monitoring of Steel Risers on Plastic Services
6. Depth of Cover Surveys
7. Geotechnical Monitoring of Pipelines in Slopes
8. Hydro Geotechnical Monitoring of Pipelines in Water courses
9. In-line Inspection
10. Aerial Pipeline Inspection
11. Leak Inspection
12. Strained Service Failure Reporting
13. Customer Meter Set Maintenance Survey
14. Station Inspections
15. Station Leak Survey
16. Odourization Equipment Inspection
17. Distribution Mains and Services Leak Survey
18. Transmission and High Pressure Mains Leak Survey
19. Public Building Leak Survey
20. Business District Leak Survey
21. Meters- Maintaining Compliance with Measurement Canada Requirements
22. Station Valve Inspection and Maintenance
23. Transmission Valve Inspection and Maintenance
24. Distribution Buried Valve Maintenance
25. Downtown Winnipeg- Emergency Sectionalization Valve Maintenance

Centra's system consists of three types of critical assets: stations and control points, pipelines, and services, as shown in Figure 4.8 below.

Figure 4.8: Critical Asset Groups

Critical Asset Groups (Total Quantity)	Critical Asset Sub-groups	Material Type		
		Steel	Plastic	Total
Stations (397) and Control Points (2,094)	Primary Stations	27	N/A-	27
	Gate Stations	119	N/A-	119
	Regulation Stations	54	N/A-	54
	Farm Taps	197	N/A-	197
	Valves	1407	687	2,094
Pipelines (16,479)	Transmission Pressure	1,860 km	N/A-	1,860 km
	High Pressure	198 km	92 km	290 km
	Medium Pressure	7,828	6501	14,329
Services (267,705)	Residential Services	247,452	N/A-	247,452
	Commercial/Industrial Services	20,253	N/A-	20,253

The following sections discuss Centra's current Asset Maintenance Strategies with respect to these critical asset groups.

Stations and Control Points

There are different maintenance strategies in use for different elements of stations and control points. Natural gas pressure regulating stations have a well-established multi-point assessment and evaluation process that is used to identify stations for upgrading or re-building. This process has been in place for over ten years and includes consideration of health and safety, compliance, station security, site, environment reliability, and public acceptance in ranking stations against each other and determining the priority of work. The evaluation process typically identifies work to be performed at two to five stations annually. Recognizing that stations include mechanical components that are susceptible to failure during operation, stations are designed with parallel, fully redundant, regulator runs to avoid a loss of service due to a single failure. Additionally, monitoring of selected stations through a fully monitored SCADA system is also provided which identifies station operating issues when they occur to permit a timely response. The present approach would be considered Condition-Based Maintenance but as it provides a relative ranking/prioritization of work between stations, it contains elements of Risk-Based Maintenance.

For stations, additional inspection and maintenance programs that support a Condition-Based Maintenance strategy would include:

- Station Inspections; and
- Station Leak Surveys.

For stations, inspection and maintenance programs that are performed on a regular schedule and would be considered to be a Time-Based Maintenance strategy include:

- Odourization Equipment Inspections;
- Station Valve Inspection and Maintenance;
- Transmission Valve Inspection and Maintenance;
- Distribution Buried Valve Maintenance; and
- Downtown Winnipeg- Emergency Sectionalization Valve Maintenance.

Pipelines

For pipeline systems, the current maintenance strategies in use include Condition-Based Maintenance and Risk-Based Maintenance.

For pipelines, inspection and maintenance programs that support a Condition-Based Maintenance strategy include:

- Cathodic protection system monitoring;
- Close Interval Potential Survey;
- Coating Shielding Corrosion;
- External Corrosion Direct Assessment;
- Depth of Cover Surveys;
- Geotechnical Monitoring of Pipelines in Slopes;
- Hydro Geotechnical Monitoring of Pipelines in Water Courses;
- In-line Inspection;
- Leak Surveys; and
- Aerial Pipeline Inspection.

In February 2018, Centra filed with the PUB its Pipeline Risk Methodology and Pipeline Risk Assessment (2017) which are associated with the Reliability-Centered

Maintenance approach. The Pipeline Risk Methodology document details the approach for pipeline risk assessment through risk analysis and risk evaluation while the Pipeline Risk Assessment document provides the current results of using the methodology on Centra's natural gas pipeline system. The pipeline system was separated into approximately 40,000 segments with similar attributes (pipe material, internal pressure, cathodic protection). Information on hazard categories as defined by the Canadian Gas Association Asset and Integrity Management task force, and historical incident data are inputs into the analysis. This approach would be considered Risk-Based Maintenance. The Pipeline Risk Assessment program is relatively new and has not yet been used to identify projects.

Services

For pipeline systems the current maintenance strategies in use include Condition-Based Maintenance, Corrective Maintenance and Risk-Based Maintenance. For services, inspection and maintenance programs that support a Condition-Based Maintenance strategy would include:

- Monitoring of Steel Risers on Plastic Services;
- Leak Inspection;
- Strained Service Failure Reporting; and
- Customer Meter Set Maintenance Survey.

The approach for replacement of residential pressure regulators is currently transitioning from a Corrective Maintenance strategy where the regulators are replaced on failure to a Condition-Based Maintenance approach where the regulators are evaluated and replaced as necessary in conjunction with meter change out activities. From January 1, 2016 to November 11, 2018, there were 17,012 regulators replaced while meter exchanges were being performed.

Centra has been accredited by Measurement Canada with the authority to perform verification and/or re-verification of natural gas meters under *The Electricity and Gas Inspection Act* (the "Act") and Regulations enacted thereto. The Act and Regulations set forth the rules for measurement of natural gas provided for sale and requires that meters used by utilities for the sale of natural gas be exchanged periodically for meter testing and verification to provide accurate measurement, for replacement of

a defective or broken meter and for meter testing to monitor compliance with the requirements of the Act. Centra follows Measurement Canada sampling and inspections procedures and specifications and conducts an annual meter compliance program to extend the seal period of in-service meters. The approach is considered to be Risk-Based Maintenance where the meters' failure is identified as a failure to meet required operating accuracies.

Figure 4.9 summarizes the current maintenance strategies for the identified Key Assets.

Figure 4.9: Maintenance Strategy- Centra's current-state

Asset Type:	Corrective Maintenance	Time-Base Maintenance	Condition-Based Maintenance	Reliability-Centered Maintenance (RCM)		
				Risk-Based Maintenance	Scenario Planning	Dynamic Strategy Assignment
Stations and Control Points:						
Stations			✓			
Valves		✓				
Pipelines			✓	✓		
Services:						
Regulators	✓		✓*			
Meters				✓		
Risers, Valves, Service line			✓			

*The approach used for the replacement of regulators is currently transitioning from Corrective Maintenance to Condition Based Maintenance.

Available Asset Condition Information

In 2016, a system asset review was performed that examined each of these critical assets with respect to degradation, asset health and risk. The results of this review can be found in the "Natural Gas System Asset Condition Assessment" provided in Appendix 4.4 to Tab 4. This report includes the following:

- a summary of the natural gas assets;
- current inspection, maintenance and replacement activities for the three critical assets;
- conclusion that the current replacement rates of assets are not consistent with the expected life expectancy; and
- identification of specific inspection activities to address gaps in asset condition information.

This assessment indicated that the current station renewal program for replacement and upgrading of pressure regulating stations is adequate. Gaps were identified in the available condition information for the pipeline and services classes and work has been initiated to obtain this information.

A significant amount of information regarding key distribution assets is currently collected as part of standardized inspection and maintenance programs. Generally, the information is obtained and retained by or on behalf of a program owner and has historically been accessible when needed by the program owner or others who have a need for information on the condition of an asset.

As noted, there are asset maintenance programs developed to sustain, and in some cases extend, the select assets' expected operational life cycle. A significant quantity of data is needed to advance the strategies that govern all key assets from reactive/condition-based toward predictive.

4.2.4 Natural Gas Evolution from Asset Maintenance to Asset Management

Future asset management work will need to go beyond asset condition to include issues such as system capacity, system resiliency and return to service capabilities and new customer additions among others. The development of a long term capital investment plan based on whole life costs of assets will assist in transitioning to a sustainable asset position. Natural gas is a commodity that customers rely on for heating and business needs while properties of the commodity pose a safety risk in the event of leaks or uncontrolled releases.

The development of risk assessment methodologies and performance of annual risk assessment reports will support the Reliability-Centered Maintenance Approach. Moving forward Centra's plans are as follows:

- Continue existing natural gas system surveys, pipeline integrity programs and maintenance activities. In addition, Centra will continue to refine, update and expand them based on new requirements or information being obtained;
- Address asset information gaps identified in the Natural Gas System Asset Condition Assessment report. As asset maintenance work continues, additional gaps are expected to be found and action will then be required to obtain the required information;
- Review current asset data storage methods and locations/availability to determine if the current practices restrict access to necessary information. Upgrades or changes will be recommended as needed;
- Participate in industry groups including Canadian Standards Association, Canadian Gas Association and the American Gas Association to gain insight on work being done by other utilities. Through these discussions Centra is identifying industry best practices and methodologies for asset replacement in congested urban areas;
- Continue planning analyses to better understand consequences associated with a component or system failure and identify options and time requirement to return a system to service following a natural gas outage. Many of the pipelines in the Centra system are single feed pipelines which results in the customers on the pipeline being vulnerable to an outage due to a single damage or failure. After the pipeline system damage has been repaired, returning service from a natural gas outage can take extensive work with each individual customer's equipment needing to be inspected and appliance operation checked. Centra has been performing planning analysis and preparing contingency plans to document return to service activities, determine suitable application of the available compressed natural gas ("CNG") resources, and identify any required pipeline projects that will assist in minimizing the size or duration of a pipeline system outage. These activities can reduce the internal costs and customer impacts of a loss of service and may permit the life extension of current assets; and

- Evaluate the work required and potential benefits of implementing a materials tracking and traceability system for pipeline materials being installed as part of new construction.

4.2.5 Annual Roadmap Plan

This section includes a summary of the annual deliverables for the next three years.

2018/19 Deliverables

- Completion of a Natural Gas Strategic Asset Management Plan that specifies how organizational objectives are to be converted to asset management objectives, the approach for developing asset management plans, and the role of the asset management system in supporting achievement of the asset management objectives;
- Initiate development of a detailed Natural Gas Asset Management Plan (AMP) that includes maintenance work, the investment program for refurbishments, renewals and new assets, and the program for disposal of assets. The AMP is planned for a ten year period and will define specific requirements including capacity, performance, condition and risk level that will be achieved from the plan; and
- Development of risk assessment methodologies and perform risk assessment reviews for above grade natural gas assets (including stations) and services including service lines and above grade components.

2019/20 Deliverables

- Continue work on the development of the AMP and initiate implementation;
- Based on the risk assessment reviews performed for each asset, initiate plans to address the highest identified risks;
- Review the current asset data storage methods and locations/availability to determine if the current practices restrict access to necessary information. Upgrades or changes will be recommended as needed;
- Evaluate the work required and potential benefits of implementing a materials tracking and traceability for pipeline system materials being installed as part of new construction; and

- Evaluation of natural gas industry software that may assist in the transition to an RCM approach.

2020/21 Deliverables

- Complete the development of the AMP and initiate implementation Review the implementation of the AMP.