Application of SOUTHERN CALIFORNIA GAS)
COMPANY for authority to update its gas revenue)
requirement and base rates)
effective January 1, 2019 (U 904-G))

Application No. 17-10-___

Exhibit No.: (SCG-08-CWP)

CAPITAL WORKPAPERS TO

PREPARED DIRECT TESTIMONY

OF MICHAEL A. BERMEL

ON BEHALF OF SOUTHERN CALIFORNIA GAS COMPANY

BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF CALIFORNIA

OCTOBER 2017

SoCalGas

A Sempra Energy utility

2019 General Rate Case - APP
INDEX OF WORKPAPERS

Exhibit SCG-08-CWP - GAS MAJOR PROJECTS

Overall Summary For Exhibit No. SCG-08-CWP

Area: GAS MAJOR PROJECTS

Witness: Michael A. Bermel

	In 2016 $ (000)		
	Adjusted-Forecast		
	2017	2018	2019
A. DISTRIBUTION OPERATIONS CONTROL CENTER	1,200	8,969	37,714
Total	**1,200**	**8,969**	**37,714**

Note: Totals may include rounding differences.

Area: GAS MAJOR PROJECTS
Witness: Michael A. Bermel
Category: A. DISTRIBUTION OPERATIONS CONTROL CENTER
Workpaper: 003430

Summary for Category: A. DISTRIBUTION OPERATIONS CONTROL CENTER

	In 2016$ (000)			
	Adjusted-Recorded	Adjusted-Forecast		
	2016	2017	2018	2019
Labor	0	0	2,920	4,412
Non-Labor	0	1,200	6,049	33,302
NSE	0	0	0	0
Total	**0**	**1,200**	**8,969**	**37,714**
FTE	0.0	0.0	16.0	16.0

003430 Distribution Operations Control Center and Technology Management

Labor	0	0	2,920	4,412
Non-Labor	0	1,200	6,049	33,302
NSE	0	0	0	0
Total	**0**	**1,200**	**8,969**	**37,714**
FTE	0.0	0.0	16.0	16.0

Note: Totals may include rounding differences.

Beginning of Workpaper Group
003430 - Distribution Operations Control Center and Technology Management

Area: GAS MAJOR PROJECTS
Witness: Michael A. Bermel
Budget Code: 00343.0
Category: A. DISTRIBUTION OPERATIONS CONTROL CENTER
Category-Sub: 1. DISTRIBUTION OPERATIONS CONTROL CENTER
Workpaper Group: 003430 - Distribution Operations Control Center and Technology Management

Summary of Results (Constant 2016 $ in 000s):

Forecast Method		Adjusted Recorded					Adjusted Forecast		
Years		2012	2013	2014	2015	2016	2017	2018	2019
Labor	Zero-Based	0	0	0	0	0	0	2,920	4,412
Non-Labor	Zero-Based	0	0	0	0	0	1,200	6,049	33,302
NSE	Zero-Based	0	0	0	0	0	0	0	0
Total		**0**	**0**	**0**	**0**	**0**	**1,200**	**8,969**	**37,714**
FTE	Zero-Based	0.0	0.0	0.0	0.0	0.0	0.0	16.0	16.0

Business Purpose:

The following provides the business purpose for the Distribution Operations Control Center and Technology Management projects identified under budget code 00343:

(00343.001 – DOCC) SoCalGas and SDG&E intend to establish a distribution Control Center that is functionally similar and integrated into to its existing transmission Gas Control Center. Control room functions include ensuring pipeline safety parameters as established by Federal and State agencies, analyzing and responding to abnormal and/or emergency situations on the pipeline system, coordinating necessary pipeline shutdowns for maintenance and/or emergency measures, and serving as a communication center between various departments conducting maintenance on the Transmission pipeline system.

(00343.002 – Methane Sensors and Fiber Projects) Fiber optic right-of-way monitors will help SoCalGas and SDG&E identify when intrusions into their pipeline rights-of-way have occurred or when a pipeline (or right-of-way) has experienced movement that might pose a threat to pipeline structural integrity. The safety of the SoCalGas/SDG&E system may be further enhanced through the addition of real-time pipeline right-of-way gas detection monitors near facilities that are high-occupancy and pose evacuation challenges, particularly where those facilities are located within 220 yards of a high-pressure, large-diameter gas transmission pipeline.

(00343.003 – Pipeline Infrastructure Management System) SoCalGas and SDG&E propose to develop a new data collection, storage, alarm processing and data management system to collect information from the field monitoring sensors described in 343.002. The proposed Pipeline Infrastructure Management System (PIMS) will provide daily sensor health/status monitoring, receive alarm information within 2-5 minutes, will report alarms to appropriate dispatch personnel for review, callout and resolution as required, will provide system-wide viewing of daily health and alarm information.

Physical Description:

Note: Totals may include rounding differences.

Area:	GAS MAJOR PROJECTS
Witness:	Michael A. Bermel
Budget Code:	00343.0
Category:	A. DISTRIBUTION OPERATIONS CONTROL CENTER
Category-Sub:	1. DISTRIBUTION OPERATIONS CONTROL CENTER
Workpaper Group:	003430 - Distribution Operations Control Center and Technology Management

The following provides the physical description for the Distribution Operations Control Center and Technology Management projects identified under budget code 00343:

(00343.001 – DOCC) The DOCC project will add RTUs control valves, valve indicators, pressure monitors, servers and modifications to existing field equipment to provide monitoring and oversight to the DOCC SCADA servers, co-located with the existing Gas Control which will be looking to migrate to a new facility in 2022. In addition to the field equipment, 32 employees (fifteen management and fifteen union) will be needed to support the project, 16 of which will need to be hired between 2017 and 2019.

(00343.002 – Methane Sensors and Fiber Projects) The Methane Sensor project will look to deploy upwards of 2,100 methane sensors along existing HCA and evacuation challenged areas. The fiber optic project will deploy several fiber monitoring stations along new and replaced transmission pipelines that meet specific operating criteria, estimated at approximately 4 operating stations per year.

(00343.003 – Pipeline Infrastructure Management System) PIMS will include new and enhanced IT system functionality along with related data transfer interfaces to various systems that include OSI PI, SAP, GIS, Esri, dispatch, field workforce order management systems, and SCG Advanced Meter and SDG&E Smart Meter (for sensor data collection). This will allow for the data management and reporting for over 2,000 methane sensors and fiber optic monitors as well as provide potential expansion capability for up to 10,000 additional pipeline monitoring sensors.

Project Justification:

The following provides the project justification for the Distribution Operations Control Center and Technology Management projects identified under budget code 00343:

(00343.001 – DOCC) The DOCC will provide SoCalGas and SDG&E enhanced system visibility and control of its Distribution medium and high pressure systems. It will provide real-time visibility into the dynamic pressures and flows within the gas distribution system. It will have remote control capability for key distribution facilities such as regulators and valves, which will enable a responsive, centralized system operation that will be integrated with the existing Transmission system control room operation. SoCalGas intends to leverage this information proactively to keep the system working normally and to prevent safety-related events. If an accident occurs despite these preventative capabilities, the DOCC will enable faster response and more robust mitigation and control. This effort is in response to the 2016 GRC filing put forth by Frank Ayala (A.14-11-004) that stated the company would develop a plan for the future of their gas distribution control functions.

(00343.002 – Methane Sensors and Fiber Projects) SoCalGas and SDG&E have put for the effort to develop and test remote methane systems and fiber optic monitoring installations which align with their proposals in their amended PSEP rulemaking R.11-02-019 along with subsequent favorable CPUC responses. In addition implementations have proven to be prudent and cost effective in pilot and test installations.

(00343.003 – Pipeline Infrastructure Management System) PIMS is the back office system to support the deployment of methane sensors and fiber monitoring stations as detailed in 00343.002. PIMS will look to interface with existing company IT systems, including SCG Advanced Meter and SDG&E Smart Meter (for methane sensor data collection), as well as GIS, SAP and Esri in order to make the data available to end users so that dispatch a

Note: Totals may include rounding differences.

Area:	GAS MAJOR PROJECTS
Witness:	Michael A. Bermel
Budget Code:	00343.0
Category:	A. DISTRIBUTION OPERATIONS CONTROL CENTER
Category-Sub:	1. DISTRIBUTION OPERATIONS CONTROL CENTER
Workpaper Group:	003430 - Distribution Operations Control Center and Technology Management

Forecast Methodology:

Labor - Zero-Based

(00343.001–DOCC) In order to implement the DOCC 6 project managers, 2 SCADA advisors, 1 PI Administrator, 1 designer, 1 engineer, 3 managers, 2 SAP FTEs and 1 field support engineer will be hired to run this project. 15 union represented instrument specialists are needed to install and maintain the field equipment. 16 people between management and union are needed between 2018 and 2019. The costs estimated for this project were based on current labor rates and historical experience based on projects similar to those done for PSEP transmission along with estimated time needed to upgrade and test equipment already in the field as was done by the EPM replacement project.

(00343.002–Methane Sensors and Fiber Projects) The Labor forecast methodology used for the Methane Sensors and Fiber Projects was based on various factors. Labor numbers were analyzed from previous related installations and modified accordingly with the scope of these projects. SoCalGas and SDG&E also completed pilot/test installations of both technologies that gave insight on related costs with deploying the systems.

(00343.003–Pipeline Infrastructure Management System) The labor costs associated with PIMS were based on recent experience by the respective IT system owners. Past experience in the IT system enhancement and data transfer interface development, testing and deployment of system capabilities and system enhancements similar in size and scope were used in the cost estimation effort. Labor estimates identified include: IT support for SAP/BI/BW system enhancement, OSI PI system development, SoCalGas Advanced Meter and NEMO vendor system enhancement project management and validation, SDGE Smart Meter vendor system enhancement project management and validation, and SDGE Smart Meter system to OSI PI interface development and validation.

Non-Labor - Zero-Based

(00343.001 – DOCC) The costs that were estimated for the DOCC project were based on known licensing costs of applications currently used by the company and general historical costs of installing equipment in the field. In addition to the costing methods above, a series of assumptions were made in order to determine the capital cost of installing a Distribution Operations Control Center including Gas Control moving to a new facility in 2022. A total of $10MM will be set aside to help with incremental costs of moving into a new facility. Cost was validated based on market estimations made by facilities.

(00343.002 – Methane Sensors and Fiber Projects) Forecasting Non-labor costs were based on contract costs and vendor quotes for similar installations in the right-of-way and on pipeline infrastructure. SoCalGas and SDG&E also analyzed vendor and contractor costs for the pilot/test installations they have performed.

(00343.003 – Pipeline Infrastructure Management System) The Non-labor costs associated with PIMS were based on recent experience by the respective IT system owners and recent vendor system cost estimations. PIMS Non-labor costs cover related hardware, software/license and vendor/contract labor support. PIMS Non-labor costs include: GIS QA/Dev environmental hardware costs, PI system software and license costs, incremental SoCalGas Advanced Meter and NEMO license costs, incremental SDGE Smart Meter license costs and interface to OSI PI vendor development costs, GIS SQL server and ESRI license costs, temporary Advanced Meter and Smart Meter hosting services, and Advanced Meter and Smart Meter system upgrade costs to meet Tier 1 requirements.

NSE - Zero-Based

None

Area: GAS MAJOR PROJECTS
Witness: Michael A. Bermel
Budget Code: 00343.0
Category: A. DISTRIBUTION OPERATIONS CONTROL CENTER
Category-Sub: 1. DISTRIBUTION OPERATIONS CONTROL CENTER
Workpaper Group: 003430 - Distribution Operations Control Center and Technology Management

Summary of Adjustments to Forecast

In 2016 $ (000)										
Forecast Method		**Base Forecast**			**Forecast Adjustments**			**Adjusted-Forecast**		
Years		**2017**	**2018**	**2019**	**2017**	**2018**	**2019**	**2017**	**2018**	**2019**
Labor	Zero-Based	0	2,920	4,412	0	0	0	0	2,920	4,412
Non-Labor	Zero-Based	1,200	6,049	33,302	0	0	0	1,200	6,049	33,302
NSE	Zero-Based	0	0	0	0	0	0	0	0	0
Total		**1,200**	**8,969**	**37,714**	**0**	**0**	**0**	**1,200**	**8,969**	**37,714**
FTE	Zero-Based	0.0	16.0	16.0	0.0	0.0	0.0	0.0	16.0	16.0

Forecast Adjustment Details

Year	Adj Group	Labor	NLbr	NSE	Total	FTE	RefID
2017 Total		0	0	0	0	0.0	
2018 Total		0	0	0	0	0.0	
2019 Total		0	0	0	0	0.0	

Note: Totals may include rounding differences.

Area: GAS MAJOR PROJECTS
Witness: Michael A. Bermel
Budget Code: 00343.0
Category: A. DISTRIBUTION OPERATIONS CONTROL CENTER
Category-Sub: 1. DISTRIBUTION OPERATIONS CONTROL CENTER
Workpaper Group: 003430 - Distribution Operations Control Center and Technology Management

Determination of Adjusted-Recorded:

	2012 ($000)	2013 ($000)	2014 ($000)	2015 ($000)	2016 ($000)
Recorded (Nominal $)*					
Labor	0	0	0	0	1,149
Non-Labor	0	0	0	0	96
NSE	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**1,245**
FTE	0.0	0.0	0.0	0.0	8.8
Adjustments (Nominal $) **					
Labor	0	0	0	0	-1,149
Non-Labor	0	0	0	0	-96
NSE	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**-1,245**
FTE	0.0	0.0	0.0	0.0	-8.8
Recorded-Adjusted (Nominal $)					
Labor	0	0	0	0	0
Non-Labor	0	0	0	0	0
NSE	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**
FTE	0.0	0.0	0.0	0.0	0.0
Vacation & Sick (Nominal $)					
Labor	0	0	0	0	0
Non-Labor	0	0	0	0	0
NSE	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**
FTE	0.0	0.0	0.0	0.0	0.0
Escalation to 2016$					
Labor	0	0	0	0	0
Non-Labor	0	0	0	0	0
NSE	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**
FTE	0.0	0.0	0.0	0.0	0.0
Recorded-Adjusted (Constant 2016$)					
Labor	0	0	0	0	0
Non-Labor	0	0	0	0	0
NSE	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**
FTE	0.0	0.0	0.0	0.0	0.0

* After company-wide exclusions of Non-GRC costs
** Refer to "Detail of Adjustments to Recorded" page for line item adjustments
Note: Totals may include rounding differences.

Area: GAS MAJOR PROJECTS
Witness: Michael A. Bermel
Budget Code: 00343.0
Category: A. DISTRIBUTION OPERATIONS CONTROL CENTER
Category-Sub: 1. DISTRIBUTION OPERATIONS CONTROL CENTER
Workpaper Group: 003430 - Distribution Operations Control Center and Technology Management

Summary of Adjustments to Recorded:

In Nominal $(000)					
Years	**2012**	**2013**	**2014**	**2015**	**2016**
Labor	0	0	0	0	-1,149
Non-Labor	0	0	0	0	-96
NSE	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**-1,245**
FTE	0.0	0.0	0.0	0.0	-8.8

Detail of Adjustments to Recorded in Nominal $:

Year	Adj_Group	Labor	NLbr	NSE	Total	FTE	RefID
2012 Total		0	0	0	0	0.0	
2013 Total		0	0	0	0	0.0	
2014 Total		0	0	0	0	0.0	
2015 Total		0	0	0	0	0.0	
2016	Other	-1,149	-96	0	-1,245	-8.8	NMOATAZE20170227111423090
Explanation:	Pipeline Safety and Reliability Project is a separate application.						
2016 Total		-1,149	-96	0	-1,245	-8.8	

Note: Totals may include rounding differences.

**Beginning of Workpaper Sub Details for
Workpaper Group 003430**

Area: GAS MAJOR PROJECTS
Witness: Michael A. Bermel
Budget Code: 00343.0
Category: A. DISTRIBUTION OPERATIONS CONTROL CENTER
Category-Sub: 1. DISTRIBUTION OPERATIONS CONTROL CENTER
Workpaper Group: 003430 - Distribution Operations Control Center and Technology Management
Workpaper Detail: 003430.001 - RAMP - Incremental Post Filing Distribution Operations Control Center

In-Service Date: 12/31/2019

Description:

This is the cost associated with bringing in the EPM hourly data directly into the Gas Control SCADA system along with real-time alarms, brining in real-time pressure data and providing remote control to high priority distribution sites.
-Migrate data from HeadEnd into Gas Control including the alarm data and its associated Trend Mode (real time) pressure data which would add roughly 24,000 tags to the SCADA system.
- A pressure monitoring device for 550 sites with a real time monitor feed and AC/Solar power necessary and an additional 8,000 tags for the SCADA System.
- Monitoring and controlling 200 regulator stations throughout the company. Two remote control valves will need to be added to the site to allow for either of the two regulator runs in at a site to but shut-in.

This will require that Gas Control move to a larger facility in order to accommodate the additional personnel necessary for monitoring the additional data. Three additional SCADA reporting sites will need to be added to accommodate the data load on the system.

Forecast In 2016 $(000)

Years	**2017**	**2018**	**2019**
Labor	0	2,920	4,412
Non-Labor	400	236	21,489
NSE	0	0	0
Total	**400**	**3,156**	**25,901**
FTE	0.0	16.0	16.0

Note: Totals may include rounding differences.

Area:	GAS MAJOR PROJECTS
Witness:	Michael A. Bermel
Budget Code:	00343.0
Category:	A. DISTRIBUTION OPERATIONS CONTROL CENTER
Category-Sub:	1. DISTRIBUTION OPERATIONS CONTROL CENTER
Workpaper Group:	003430 - Distribution Operations Control Center and Technology Management
Workpaper Detail:	003430.001 - RAMP - Incremental Post Filing Distribution Operations Control Center

RAMP Item # 1

RAMP Chapter: SCG-10

Program Name: Distribution Operations Control Center

Program Description: This program will bring in the EPM hourly data directly into the Gas Control SCADA system along with real-time alarms, along with hourly core and non-core customer data. The DOCC will also bring in real-time pressure data and provide remote control to high priority distribution sites which will provide greater visibility of the distribution system. Creating a distribution operations control center can allow for more data to be monitored and analyzed for the purpose of safety, pipeline reliability, more efficient emergency response and improving environmental performance.

Risk/Mitigation:

Risk: SCG Medium-Pressure Pipeline Failure

Mitigation: Gas Control Operation

Forecast CPUC Cost Estimates ($000)

	2017	2018	2019
Low	0	0	0
High	400	3,156	25,901

Funding Source: CPUC-GRC

Forecast Method: Zero-Based

Construction Start Date: 01/01/2017

Work Type: Mandated

Work Type Citation: PUC GO-112

Historical Embedded Cost Estimates ($000)

Embedded Costs: 0

Explanation: This is a new program.

Area: GAS MAJOR PROJECTS
Witness: Michael A. Bermel
Budget Code: 00343.0
Category: A. DISTRIBUTION OPERATIONS CONTROL CENTER
Category-Sub: 1. DISTRIBUTION OPERATIONS CONTROL CENTER
Workpaper Group: 003430 - Distribution Operations Control Center and Technology Management
Workpaper Detail: 003430.002 - Methane Sensors & Fiber Projects

In-Service Date: 12/31/2019

Description:

Install 2 100 Methane Detectors along High Pressure Pipelines in High Consequence Areas(HCA) and evacuation challenged areas. Methane Sensing units to provide 1000ppm or greater gas detection and enable detection of methane at ¼ of the amount detectable by human's ability to smell. The sensors will report information about its health and methane levels to the PIMS at a minimum of once per day and it will report alarms within 2-5 minutes. The Fiber Optics Project will be installing several monitoring stations (estimated at 2 per year) to monitor new/replacement High Pressure Pipelines that meet company criteria for third-party intrusion, subsidence and leaks along the pipeline route. These monitoring stations will consist of instrumentation that scans the fiber for any changes and reports any abnormal readings as alarms within 2-5 minutes.

Forecast In 2016 $(000)			
Years	**2017**	**2018**	**2019**
Labor	0	0	0
Non-Labor	300	4,813	4,813
NSE	0	0	0
Total	**300**	**4,813**	**4,813**
FTE	0.0	0.0	0.0

Note: Totals may include rounding differences.

Area:	GAS MAJOR PROJECTS
Witness:	Michael A. Bermel
Budget Code:	00343.0
Category:	A. DISTRIBUTION OPERATIONS CONTROL CENTER
Category-Sub:	1. DISTRIBUTION OPERATIONS CONTROL CENTER
Workpaper Group:	003430 - Distribution Operations Control Center and Technology Management
Workpaper Detail:	003430.003 - Pipeline Infrastructure Monitoring System
In-Service Date:	12/31/2019

Description:

The Pipeline Infrastructure Management System project looks deploy a new data collection, storage, alarm processing and data management system to collect information from methane sensor and fiber optic pipeline monitoring station described in 343.002. The proposed Pipeline Infrastructure Management System (PIMS) will provide daily sensor health/status monitoring, receive alarm information within 2-5 minutes, will report alarms to appropriate dispatch personnel for review, callout and resolution as required, will provide system-wide viewing of daily health and alarm information. PIMS will look to interface with existing company IT systems, including SCG Advanced Meter and SDG&E Smart Meter for methane sensor data collection), as well as GIS, SAP, Esri and other company systems.

Forecast In 2016 $(000)

Years	2017	2018	2019
Labor	0	0	0
Non-Labor	500	1,000	7,000
NSE	0	0	0
Total	**500**	**1,000**	**7,000**
FTE	0.0	0.0	0.0

Note: Totals may include rounding differences.

Supplemental Workpapers for Workpaper Group 003430

Distribution Operations Control Center Supplemental WP

Appendix

SoCalGas and SDG&E intend to establish a Distribution Operation Control Center (DOCC) that is functionally similar and integrated into to its existing transmission Gas Control Center. Control room functions include ensuring pipeline safety parameters as established by Federal and State agencies, analyzing and responding to abnormal and/or emergency situations on the pipeline system, coordinating necessary pipeline shutdowns for maintenance and/or emergency measures, and serving as a communication center between various departments conducting maintenance on the Transmission pipeline system.

The DOCC will provide SoCalGas and SDG&E enhanced system visibility and control of its Distribution medium and high pressure systems. It will provide real-time visibility into the dynamic pressures and flows within the gas distribution system. It will have remote control capability for key distribution facilities such as regulators and valves, which will enable a responsive, centralized system operation that will be integrated with the existing Transmission system control room operation. SoCalGas intends to leverage this information proactively to keep the system working normally and to prevent safety-related events. If an accident occurs despite these preventative capabilities, the DOCC will enable faster response and more robust mitigation and control. This effort is in response to the 2016 GRC filing put forth by Frank Ayala (A.14-11-004) that stated the company would develop a plan for the future of their gas distribution control functions.

The DOCC will add RTUs control valves, valve indicators, pressure monitors, servers and modifications to existing field equipment to provide monitoring and oversight to the DOCC SCADA servers, co-located with the existing Gas Control which will be looking to migrate to a new facility in 2022.

Below are the work papers, assumptions and figures that were used to develop and cost estimate the proposed Distribution Operations Control Center for SoCalGas and SDG&E.

A1. Capital Costs

The summary of the capital work to be completed for the period 2017-2019 includes:

- 2017 – Complete preliminary technical specifications and foundational work to test (3) three different types of control and monitoring field asset configurations with the Company's existing gas control facility (see Figures 6, 7 and 8)
- 2018 – Design and test year:
  - Complete detailed engineering specifications for the new Distribution Operations and Control Center system and complete review of over 3,000 remote sites for monitoring and control upgrade modification scope options;
  - Complete the commissioning of five (5) each of the following types of site installations with tie-in to the existing transmission SCADA system:
    - Hourly EPM stations: Providing pipeline pressure reads at hourly intervals and real-time pressure alarming and 1-minute trend viewing when over or under-pressure limits or abnormal pressure profiles are measured
    - Hourly customer data for end-point installations to provide for statistical determination/triangulation of hourly core/non-core load.
      - Hourly core customer gas meter consumption data
      - Hourly non-core customer flow, temperature and pressure data
    - Real-time pipeline pressure monitoring stations
    - Full regulator station control and monitoring station – retrofitting existing regulator stations.
- 2019 – First full year of significant implementation: Complete field installation of: 562 Hourly EPM Sites, 167 Real-time monitoring sites, 50 full control sites, 875 Core and 370 non-core customer end-point installations
- 2020-2022: Complete 6,046 remaining field site installations and full Operations Control Center and SCADA commissioning, including re-location of the DOCC systems and assets into a new combined Gas Control/DOCC facility.

Table 1 below provides a schedule of field site installations which will be placed in service each year. These assets will be data-linked to Gas Control (placed in operation) in the DOCC in the years indicated.

Approximate Capital Installation Schedule							
Installation Year	2017	2018	2019	2020	2021	2022	Subtotal
Hourly EPM Units Installed	0	5	562	562	562	559	2250
Real-time Monitoring Units Installed	0	5	167	167	167	159	665
Hourly Core Customers	0	5	875	875	875	870	3500
Hourly Non-Core Customers	0	5	370	370	370	365	1480
Control RTUs installed	0	5	50	50	50	45	200
Totals:	0	25	2049	4073	6097	8095	8095

Table 1: Unit Installation Breakdown

There will be roughly 2,049 sites modified or newly installed by 2019. The capital costs of the design and implementation of those sites are shown in Table 2.

2016 Direct Capital Cost by Year - Direct w/o AFUDC				
Installation Year	2017	2018	2019	Subtotal
Total Capital Cost	$ 400	$ 3,156	$ 25,901	$ 29,537
SCG	$ 400	$ 2,462	$ 20,203	$ 23,039
SCDG&E	$ -	$ 694	$ 5,698	$ 6,498

Table 2: 2017-2019 Capital Costs
(Costs in Thousands of Dollars)

The cost breakdown between SCG and SDG&E is dependent on the ratio of supply line regulator station, also factoring in the cost of EPM replacement for SDG&E sites as shown in Table 3.

District and Supply Line Reg. Stations Utility Allocation	*Ratio of reg stations of SDG&E vs SCG*	
	SDGE	SCG
Relative ratio of distribution regulator stations	492	1945
% of utility total (allocation)	21.69%	78.31%
Distribution allocation	22%	78%
Transmission allocation	0%	0%

Table 3: Project Cost Allocation
(Adjusted to Account for EPM Replacement)

The costs for the DOCC are split up between Distribution, Engineering and Gas Control per each company and are divided out for GRC years 2017 through 2019 in Table 4 while the entire project cost is shown in Table 5.

Year Capital	2017	2018	2019
SDGE Dist -Labor	$ -	$ 45	$ 456
SDGE Dist Non-labor	$ -	$ 16	$ 1,285
SDGE Gas Control- Labor	$ -	$ 3	$ 253
SDGE Gas Control - non Labor	$ -	$ 6	$ 470
SDGE Engineering- Labor	$ -	$ 2	$ 185
SDGE Engineering - non Labor	$ -	$ 29	$ 2,385
SCG Dist - Labor	$ -	$ 177	$ 1,662
SCG Dist non-Labor	$ -	$ 57	$ 4,640
SCG Gas Control Labor	$ -	$ 284	$ 1,187
SCG Gas Control non-Labor	$ -	$ 21	$ 4,098
SCG Engineering Labor	$ 400	$ 2,408	$ 669
SCG Engineering non-Labor	$ -	$ 106	$ 8,611
Total Plan	**$ 400**	**$ 3,156**	**$ 25,901**

Table 4: 2017-2019 Capital Cost Breakdowns
(Costs in Thousands of Dollars)

Year Capital	2017	2018	2019	2017-2019 Total	2020-2022 Total	2017-2022 Project Total
SDGE Dist -Labor	$ -	$ 45	$ 456	$ 501	$ 1,244	$ 1,745
SDGE Dist Non-labor	$ -	$ 16	$ 1,285	$ 1,301	$ 3,839	$ 5,139
SDGE Gas Control- Labor	$ -	$ 3	$ 253	$ 256	$ 756	$ 1,012
SDGE Gas Control - non Labor	$ -	$ 6	$ 470	$ 476	$ 1,405	$ 1,881
SDGE Engineering- Labor	$ -	$ 2	$ 185	$ 187	$ 553	$ 741
SDGE Engineering - non Labor	$ -	$ 29	$ 2,385	$ 2,414	$ 7,124	$ 9,539
SCG Dist - Labor	$ -	$ 177	$ 1,662	$ 1,840	$ 4,491	$ 6,330
SCG Dist non-Labor	$ -	$ 57	$ 4,640	$ 4,697	$ 13,860	$ 18,557
SCG Gas Control Labor	$ -	$ 284	$ 1,187	$ 1,471	$ 2,730	$ 4,202
SCG Gas Control non-Labor	$ -	$ 21	$ 4,098	$ 4,119	$ 14,671	$ 18,790
SCG Engineering Labor	$ 400	$ 2,408	$ 669	$ 3,477	$ 1,998	$ 5,475
SCG Engineering non-Labor	$ -	$ 106	$ 8,611	$ 8,718	$ 25,724	$ 34,441
Total Plan	**$ 400**	**$ 3,156**	**$ 25,901**	**$ 29,457**	**$ 78,394**	**$ 107,851**

Table 5: 2017-20122 Capital Cost Breakdowns
(Costs in Thousands of Dollars)

The total capital costs for the DOCC are shown in Table 6.

2016 Direct Capital Cost by Year - Direct without AFUDC	
	Subtotal
Capital Cost	**$ 107,851**
Labor	**$ 19,504**
Non-labor	**$ 88,347**

Table 6: Total Capital Costs
(Costs in Thousands of Dollars)

The cost of the DOCC was split up between project management and engineering, field work, IT and Gas Control, contract work, and increased incremental costs for a facility upgrade. These cost breakdowns for the entirety of the project are shown in Table 7.

2016 Direct Capital Cost - Direct without AFUDC	
	Project Cost
Project Management/Engineering Design and Specifications	**$ 5,300**
Field Site Modifications	**$ 29,992**
Telecom/SCADA/IT	**$ 15,980**
Facility Upgrade/Incremental	**$ 12,000**
Contract	**$ 44,579**
Total	**$ 107,851**
Labor	$ 19,504
Non-Labor	$ 88,347

Table 7: Total Capital Costs
(Costs in Thousands of Dollars)

A2. Capital Cost Estimation Method

This appendix will cover the cost associated with bringing in the EPM hourly data directly into the Gas Control SCADA system along with real-time alarms, along with hourly core and non-core customer data. The DOCC will also bring in real-time pressure data and provide remote control to high priority distribution sites which will provide greater visibility of the distribution system. Creating a distribution operations control center can allow for more data to be monitored and analyzed for the purpose of safety, pipeline reliability, more efficient emergency response and improving environmental performance.

The costs that were estimated for this project were based on current labor rates, known licensing costs of applications currently used by the company and general historical costs of installing equipment in the field. In addition to the costing methods above, a series of assumptions were made in order to determine the capital cost of installing a Distribution Operations Control Center:

Overview of Basic Assumptions and factors used for capital cost estimations:

1. Six (6) project managers, 2 SCADA advisors, 1 PI Administrator, 1 designer, 1 engineer, 3 managers, 2 SAP FTEs and 1 field support engineer will need to be hired to run this project
    a. Gas Control: 2 SCADA Advisors, 1 PI administrator, 1 Manager
    b. Distribution: 2 Distribution Operations Managers, 2 SAP FTEs
    c. Engineering: 6 Project Managers, 1 designer, 1 engineer, 1 Field Support Engineer
2. Fifteen union instrument specialists will need to be hired
3. Existing Gas Control and the new Distribution Operations Control Center will share the same facility but be separated by different control rooms
4. Gas Control will need to move facilities. $10MM will be set aside to help with incremental costs of moving into a new facility. Cost was validated based on market estimations by facilities.
5. Four additional SCADA sites will be needed to bring in field data into the control center

<u>Hourly EPM Monitoring Assumptions:</u>

1. A half a day of work will need to be performed by the field tech to install the updated software and test the unit
2. Assumes change to AM system is at year 5 of a 20 year system life
3. Assumes a reaming AM system operating life of 15 years.
4 .The EPMs are being replaced at the cost of another project but the Batteries and MTUs are being replaced by this project
5. Assumes the change out of non-Solar panel EPMs to new Honeywell EPM with low battery consumption cell modem without the need of a solar panel.
6. The cost of replacing the 450 units at SDG&E is $2,874,600 when accounting for the hardware and labor

<u>Real-time EPM Assumptions:</u>

1. Three days of union labor support per site will be needed
2. An EPM or equivalent piece of equipment and a radio will be needed per site
3. The sites will run on either solar or AC power
4. At least half of the sites will need permitting
5. One hundred and sixty-seven sites will be completed each year for four years

<u>Hourly Core Assumptions:</u>

1. A half a day of work will need to be performed by the field tech to install the updated software and test the unit
2. Assumes that the existing meters will not need to be replaced to update the modules
3. Assumes the 3000 SCG module replacements will run $40 while the 500 SDG&E modules will be $55
4. Assumes a half a million for the module upgrade
5. Assumes no power is needed at the meter

<u>Hourly Non-Core Assumptions:</u>

1. Six (6) hours of work will need to be performed by the field tech to install the updated module and test the unit
2. Assumes that the existing meters will not need to be replaced to update the modules
3. Assumes the meters will utilize the existing AM Non-core modules while flow computers will utilize existing native telemetry (i.e. Cell, telephone, etc.)
4. 1,335 Units from SCG - 80% (1068) are on the AM system & 20% (267) are on the Autosol System (Flow Computers)
   4a. AM system needs an interface upgrade
   4b. Flow Computers collected by MDO need to have a new interface and power.
5. Units from SDG&E - 80% (116) need EPM replacements and 20% (29) are flow computers
   5a. Flow computers need power

Control Site Assumptions:

1. Two weeks of union labor support per site will be needed
2. A new vault will need to be constructed at each site for the control valves
3. An electrical panel, SCADAPack Panel, RTU, four pressure transmitters, limit switches and a radio will be needed per site
4. The sites will run on either solar or AC power
5. Roughly fifty percent of the sites will need permitting
6. Fifty sites will be completed each year for four years

A3. Architecture

The DOCC will look to make modifications to EPM, Core and Non-Core sites and to install real-time monitoring and control sites. The site schematics for all of these site types can be seen in Figures 1-8.

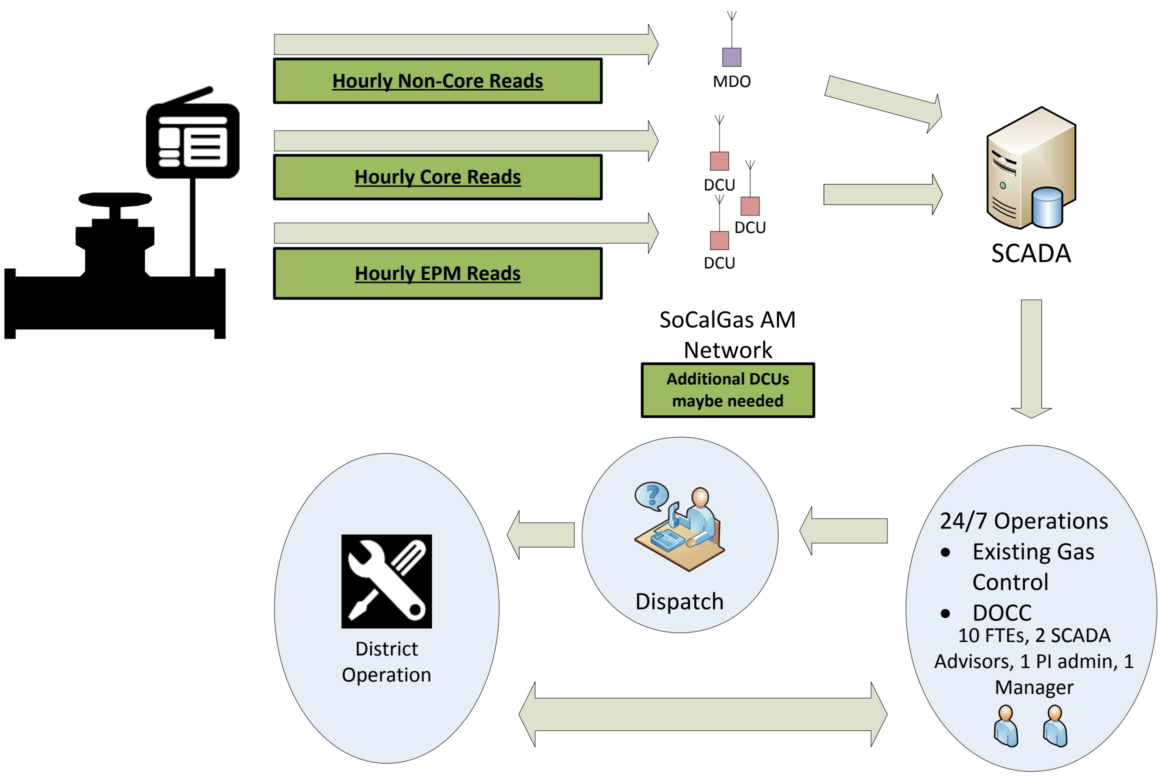


Figure 1: Hourly Data
EPMs, Core and Non-Core Data

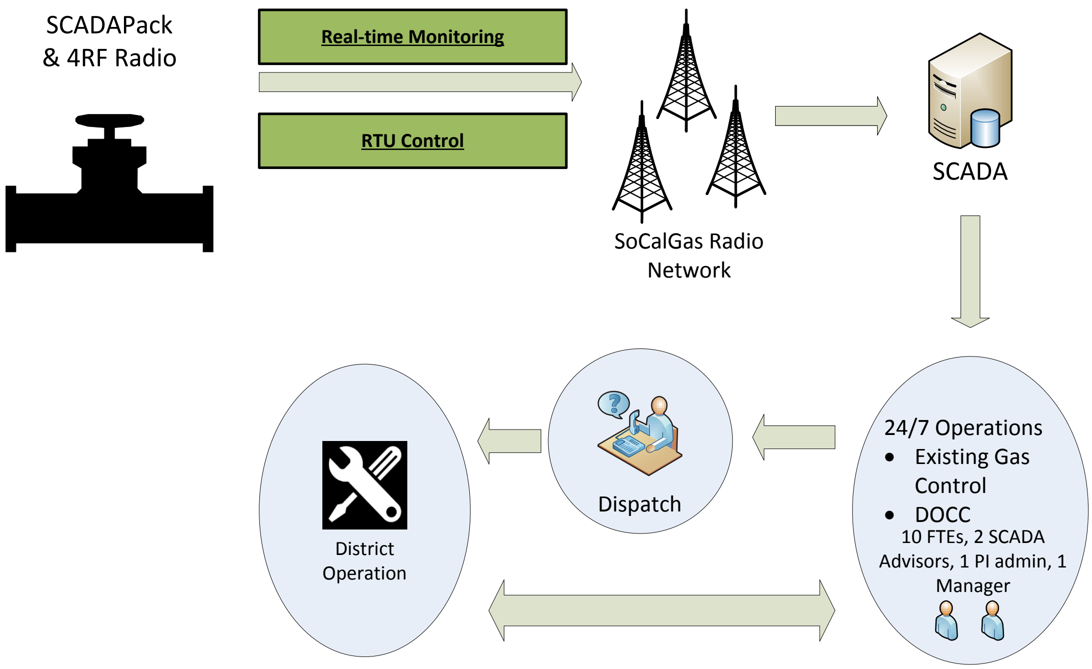


Figure 2: Real-time Monitoring and Control Sites

At approximately 2,500 sites, data from the company's EPM field systems will provide hourly pressure data (maximum, minimum and average pressure) to the DOCC. These stations will also be capable of sending pressure data in real-time to the DOCC for up to four (4) hours in the event of any low-pressure or high-pressure alarm caused by an unplanned pipeline event or emergency. Most of these sites will be operate on battery with some including solar charging. This field configuration is shown in Figure 3.

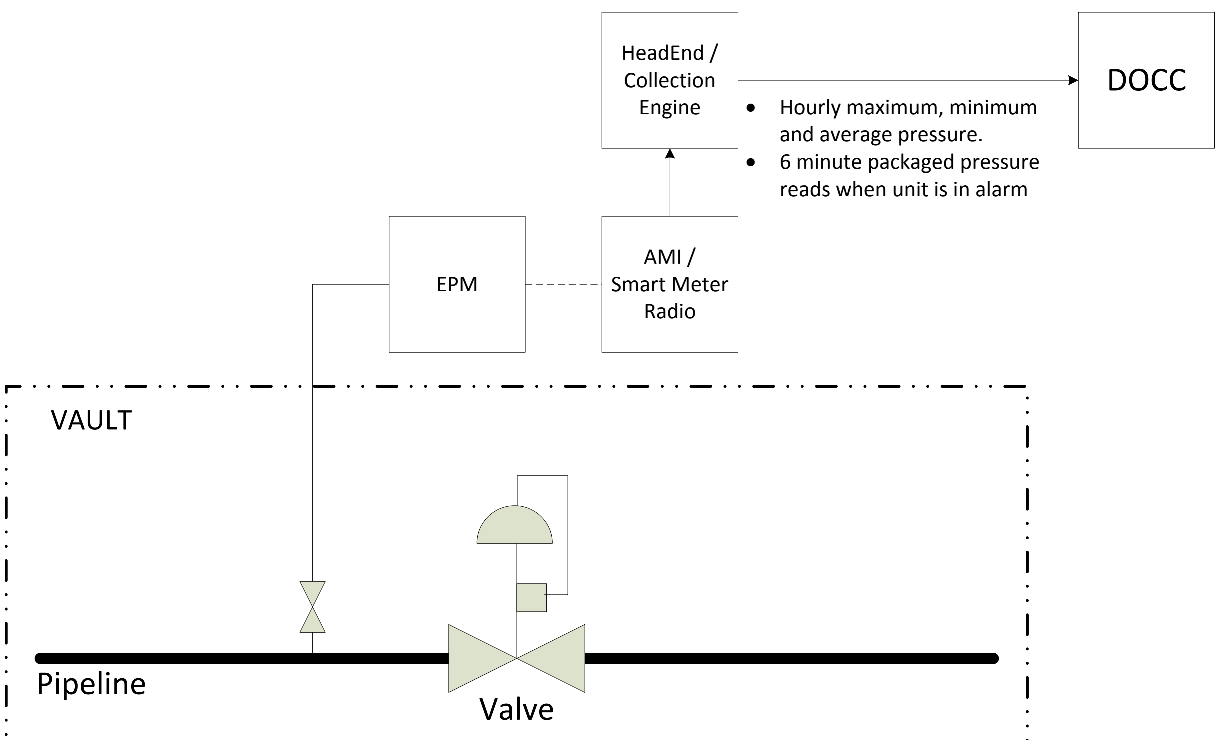


Figure 3: EPM Site Schematic

At over approximately 5,000 sites, SoCalGas and SDG&E will install equipment to provide for hourly aggregate customer information to be routed through their respective Advanced/Smart meter systems and to the DOCC; to provide for improved intra-day system send-out forecasts in support of transmission system operations. See Figures 4 and 5.

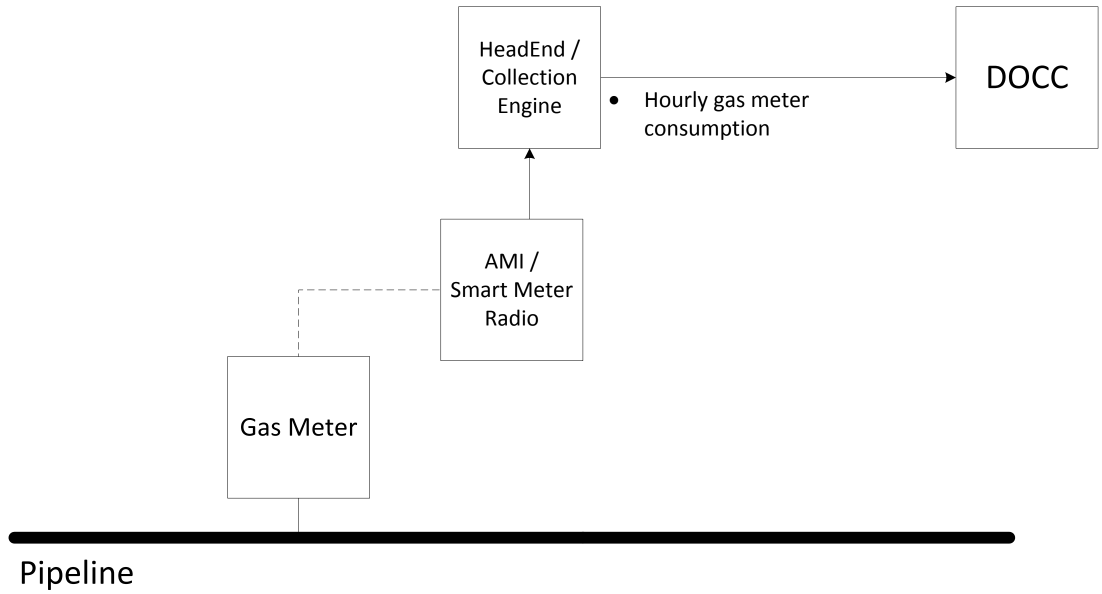


Figure 4: Core Site Schematic

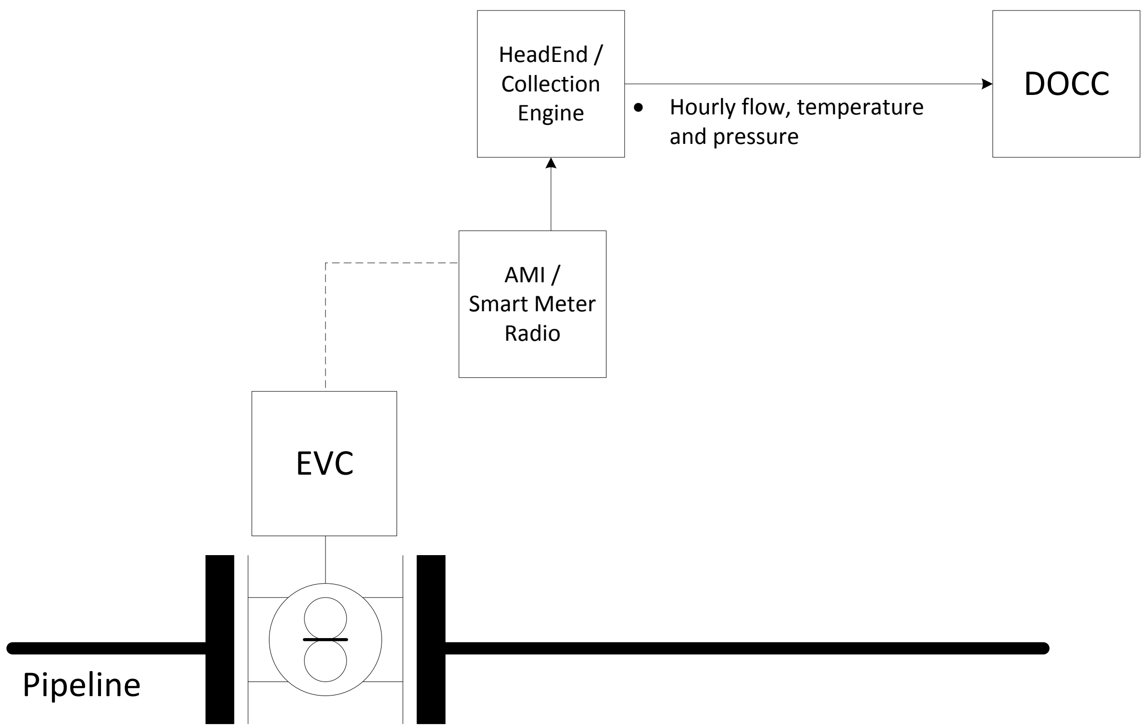


Figure 5: Non-Core Site Schematic

At 665 locations, SoCalGas and SDG&E will monitor valve and/or regulator station upstream and/or downstream pressures in real-time (see Figure 6). This scope will include at least one regulator station serving each of the companies' 650+ pressure districts/zones. Valve position monitoring, station flow and/or the ability to operate valves/regulator via some pilot regulator controls may also be included in these site modifications.

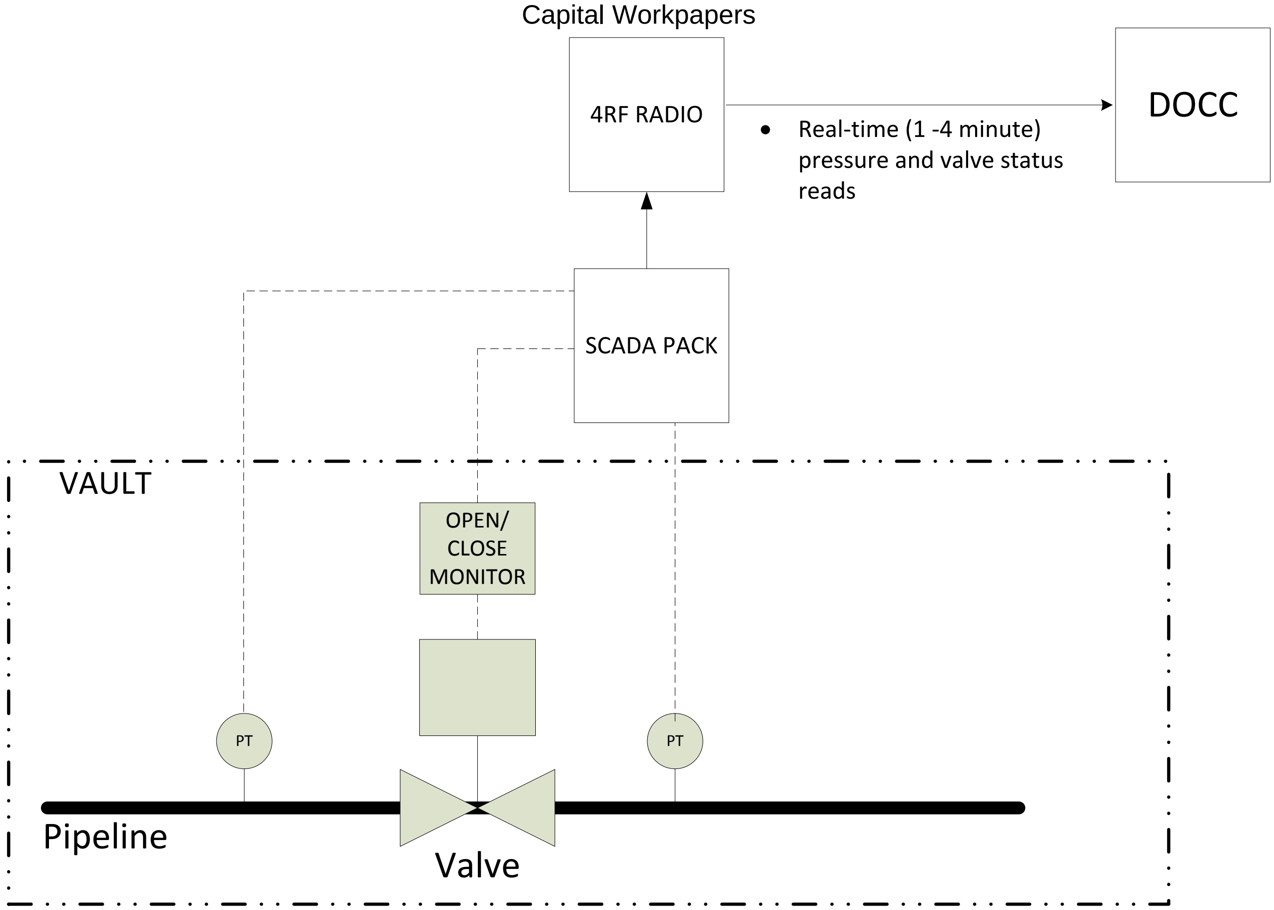


Figure 6: Real-time Monitoring Site Schematic

Figure 7 shows the general control of dual-run district regulator station with monitoring points. Shut-off control of one or both regulating runs for the station will be supported by the installation of (2) two new remote control valves installed in a vault on the inlet side of the station. SoCalGas and SDG&E plan to install this control feature at 200 locations. The locations to be selected will provide the greatest ability to continue to serve customers in the event of a pipeline rupture incident, and/or to equip our operations group with the ability to avoid an over pressure incident under a regulator station failure condition.

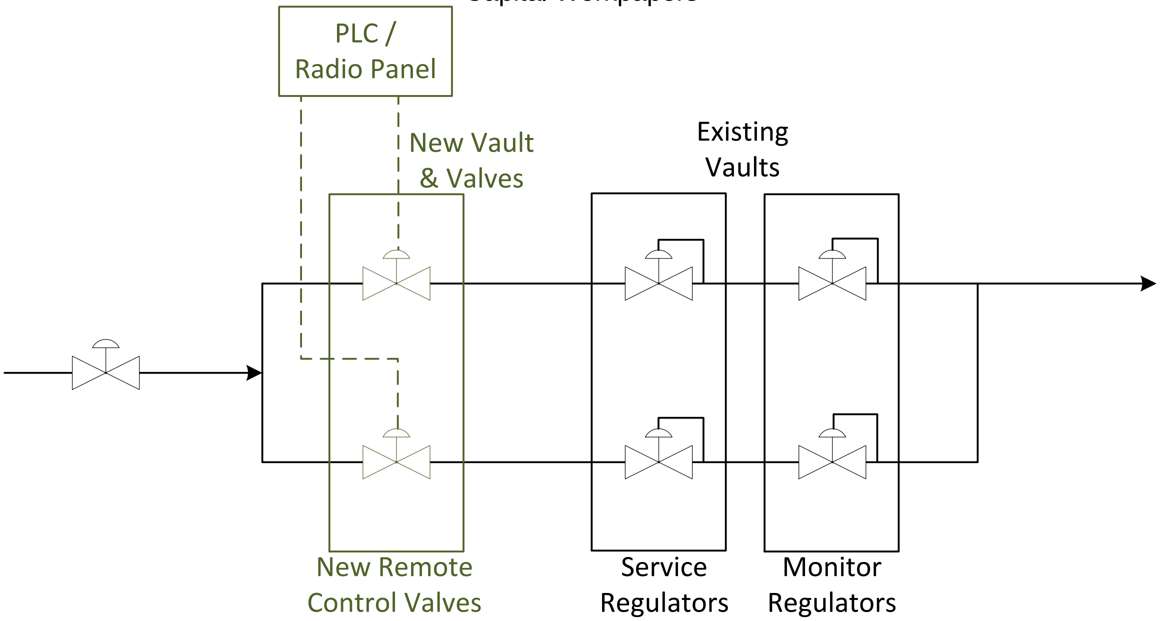


Figure 7: RCV Site Schematic

Figure 8 shows detail on how each RCV upstream of a regulator station will be equipped for remote operation and monitoring. Each valve will have an actuator for remote signal closure, along with telemetry points to monitor pressure on both sides of the valve. Outlet pressure and flow thru the regulator stations will also be monitored (not shown).

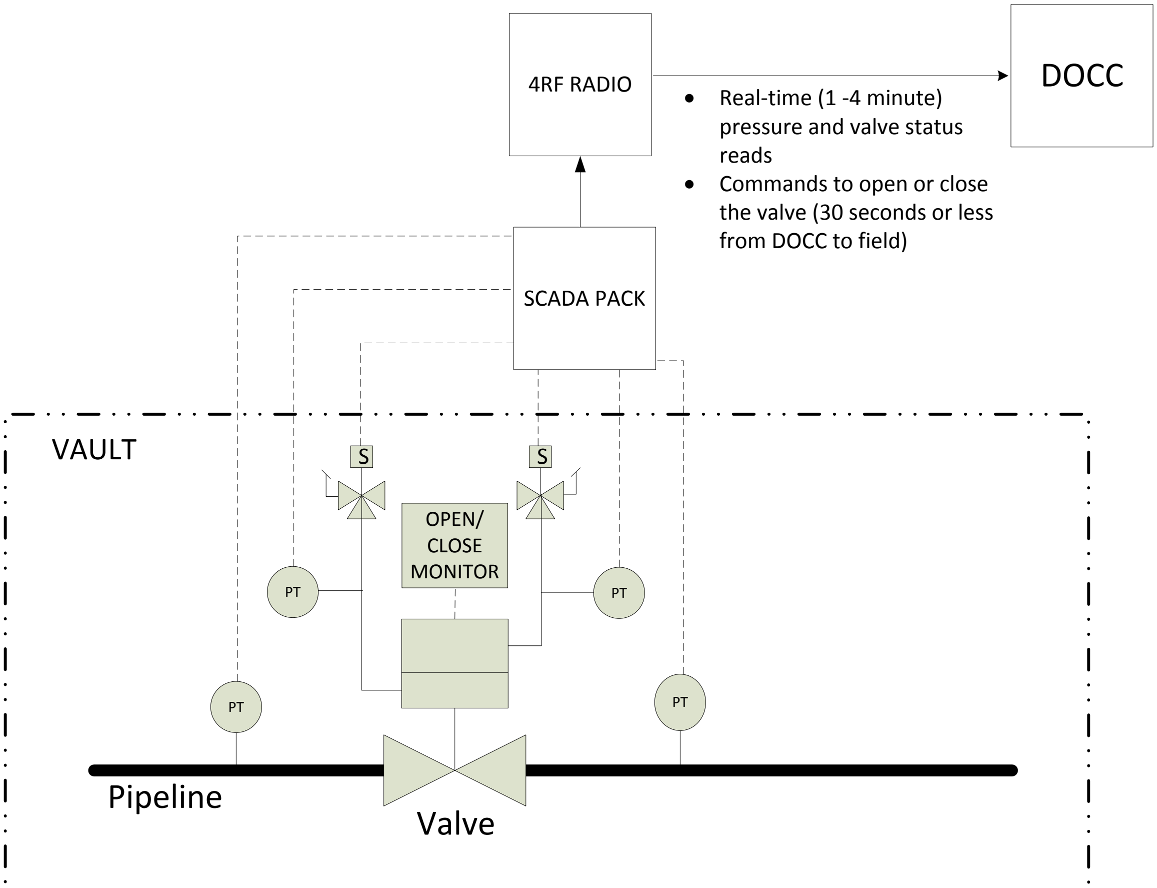


Figure 8: Remote Control Valve Schematic

DOCC will be integrated into to the existing transmission Gas Control Center which currently collects data from gas storage facilities, compressor stations, PSEP transmission and distribution valves, transmission pipeline sites and collection sites as shown in Figure 9.

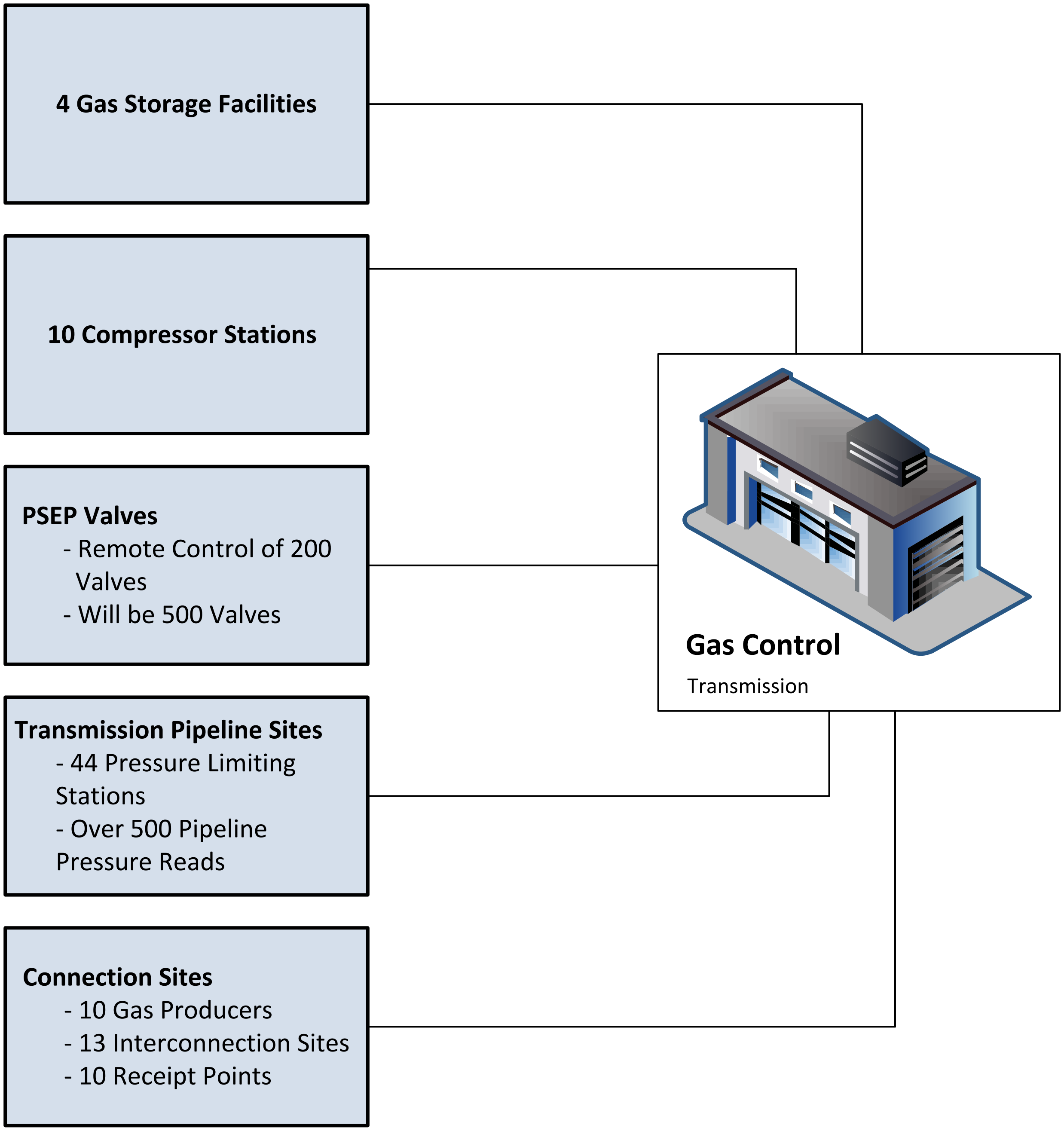


Figure 9: Existing Gas Control Data Architecture

DOCC will be adding 200 control sites and 665 real-time monitoring sites along with modifying 2,250 EPM, 3,500 core and 1,480 non-core meters to send data to the new control center. It will also improve communications between the control center, dispatch and operations. The proposed setup is modeled by Figure 10.

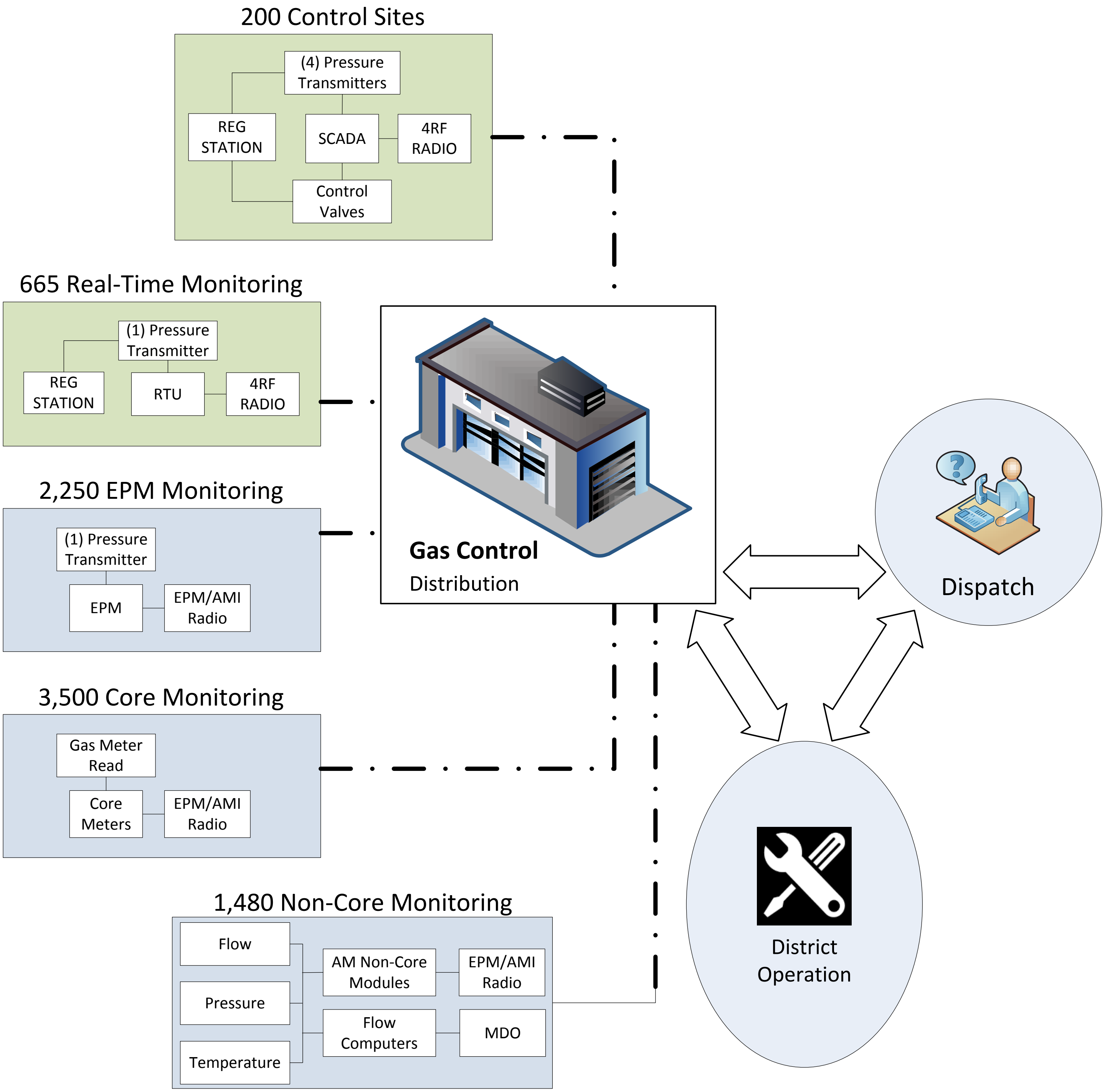


Figure 10: DOCC Additional Data Architecture

The proposed control operations setup which will include both the current transmission setup and the new DOCC setup is shown in Figure 11.

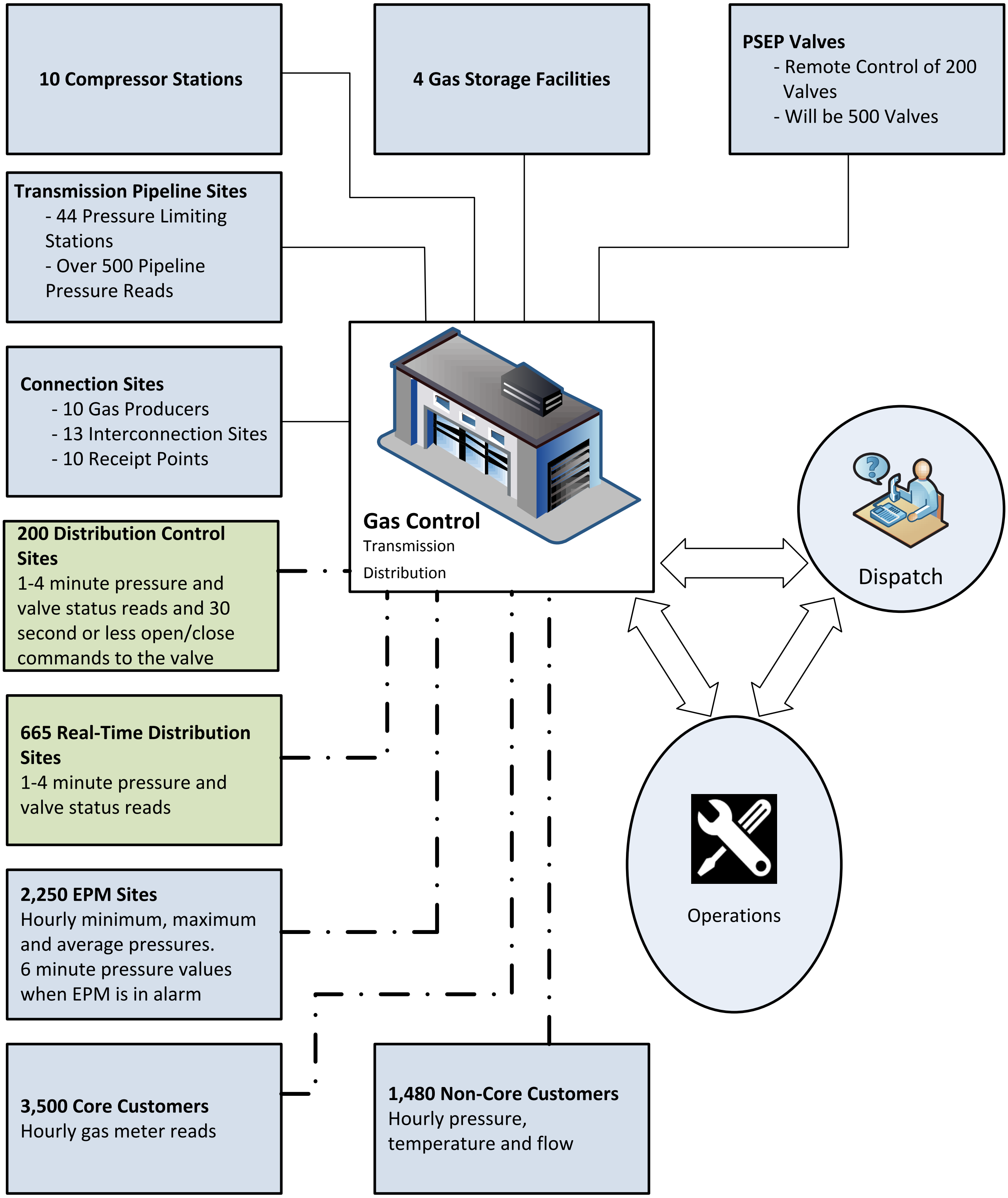


Figure 11: Proposed Future Data Architecture

A4. O&M Costs

The Operation and Maintenance (O&M) costs that were estimated for this project were based on current labor rates and historical experience based on projects similar to those done for PSEP transmission along with estimated time needed to inspect and replace equipment already in the field. The labor and non-labor O&M costs are shown in Table 7.

Operating and Maintenance Cost by Year Direct			
Year	**2017**	**2018**	**2019**
TOTAL	**$ -**	**$ 17**	**$ 1,399**
Labor	**$ -**	**$ 12**	**$ 997**
Non-labor	**$ -**	**$ 5**	**$ 401**

Table 7: 2017-2019 Operation and Maintenance Costs
(Costs in Thousands of Dollars)

The cost breakdown of O&M costs is broken down the same way that it was for capital as was shown by Figure 3 above. However, as a majority of the major work done in 2017-2019 will reside on the SoCalGas system so it is estimated that they will take the full O&M costs for those years (as shown in Table 8) and SDG&E will begin to see an increase in O&M in 2020 (shown in Table 9).

Year **O&M**	**2017**	**2018**	**2019**
SDGE Dist -Labor	$ -	$ -	$ -
SDGE Dist Non-labor	$ -	$ -	$ -
SDGE Gas Control- Labor	$ -	$ -	$ -
SDGE Gas Control - non Labor	$ -	$ -	$ -
SDGE Engineering- Labor	$ -	$ -	$ -
SDGE Engineering - non Labor	$ -	$ -	$ -
SCG Dist - Labor	$ -	$ 6	$ 474
SCG Dist non-Labor	$ -	$ 2	$ 201
SCG Gas Control Labor	$ -	$ 5	$ 409
SCG Gas Control non-Labor	$ -	$ 2	$ 201
SCG Engineering Labor	$ -	$ 1	$ 115
SCG Engineering non-Labor	$ -	$ -	$ -
Total Plan	**$ -**	**$ 17**	**$ 1,399**

Table 8: 2017-2019 Operation and Maintenance Cost Breakdowns
(Costs in Thousands of Dollars)

Year O&M	2017	2018	2019	2017-2019 Total	2020-2022 Total	2017-2022 Project Total
SDGE Dist -Labor	$ -	$ -	$ -	$ -	$ 916	$ 916
SDGE Dist Non-labor	$ -	$ -	$ -	$ -	$ 388	$ 388
SDGE Gas Control- Labor	$ -	$ -	$ -	$ -	$ 791	$ 791
SDGE Gas Control - non Labor	$ -	$ -	$ -	$ -	$ 388	$ 388
SDGE Engineering- Labor	$ -	$ -	$ -	$ -	$ 222	$ 222
SDGE Engineering - non Labor	$ -	$ -	$ -	$ -	$ -	$ -
SCG Dist - Labor	$ -	$ 6	$ 474	$ 479	$ 3,307	$ 3,786
SCG Dist non-Labor	$ -	$ 2	$ 201	$ 203	$ 1,400	$ 1,603
SCG Gas Control Labor	$ -	$ 5	$ 409	$ 414	$ 2,854	$ 3,268
SCG Gas Control non-Labor	$ -	$ 2	$ 201	$ 203	$ 1,400	$ 1,603
SCG Engineering Labor	$ -	$ 1	$ 115	$ 116	$ 801	$ 917
SCG Engineering non-Labor	$ -	$ -	$ -	**$ -**	$ -	$ -
Total Plan	**$ -**	**$ 17**	**$ 1,399**	**$ 1,416**	**$ 12,467**	**$ 13,882**

Table 9: 2017-2022 Operation and Maintenance Cost Breakdowns
(Costs in Thousands of Dollars)

The complete O&M cost for the DOCC through 2026 can be seen in Table 10.

Operating and Maintenance Cost by Year - Direct							
Year	**2017**	**2018**	**2019**	**2020**	**2021**	**2022-2026**	**10 Year Subtotal**
TOTAL	**$ -**	**$ 17**	**$ 1,399**	**$ 2,780**	**$ 4,162**	**$ 5,525**	**$ 35,984**
Labor	$ -	$ 12	$ 997	$ 1,983	$ 2,968	$ 3,940	**$ 25,661**
Non-labor	$ -	$ 5	$ 401	$ 798	$ 1,194	$ 1,585	**$ 10,323**

Table 10: 10 year Operation and Maintenance Cost Breakdowns
(Costs in Thousands of Dollars)

A5. O&M Cost Estimation Method

Cost estimation for general operations and maintenance for the DOCC was based on historical labor and equipment costs associated with what is currently performed at similar transmission sites. In addition to the needed working hours required to operate and maintain these new and upgraded sites there is an additional cost associated with facility costs and annual software costs.

In addition to the costing methods above, a series of assumptions were made in order to determine the operation and maintenance cost of installing a Distribution Operations Control Center:

Overview of Basic Assumptions for O&M cost computation:

1. Ten (10) control room FTEs, 2 SCADA advisors, 1 control room manager, 1 troubleshooting engineer, three gas system planning engineers, and 2 distribution operation managers will need to be hired
    a. Gas Control: 2 SCADA Advisors, 1 PI administrator, 1 Manager
    b. Distribution: 2 Distribution Operations Managers
    c. Engineering: 3 Gas System Planning Engineers, 1 Field Support Engineer
2. Fifteen (15) union instrument specialists will need to be dedicated to maintaining and operating the distribution sites monitored by the Distribution Operations Control Center
3. Additional facility operational costs will be needed for utilities and misc. supplies
4. A majority of work done in 2017-2019 will be on the SCG system so they will take the full O&M costs for those years

Hourly EPM Assumptions:

1. Assumes total of 4 hours per year per site by technician for each , metering station, including travel time, for routine checks, troubleshooting/repair and occasional module replacement. Non-labor assumes misc. travel expenses associate with site visits.
2. Assumes a DCU Backhaul increase of $15/month per DCU for 256MB to $25/month per DCU for 2GB for approximately 5% DCU population.

Real-Time EPM Assumptions:

1. Assumes total of 26 hours per year per site by technician for each including travel time, for routine checks, troubleshooting/repair and occasional parts replacement. Non-labor assumes misc. travel expenses associate with site visits.

Non-Core Assumptions:

1. Two and a half hours of maintenance and labor per device
2. An additional $20/site for electrical power
3. An additional $43/site for communications upgrades

Core Assumptions:

1. One and a half hours of additional maintenance and labor per device
2. An additional $11/site for communications upgrades

Control Site Assumptions:

1. Assumes total of 26 hours per year per site by technician for each including travel time, for routine checks, troubleshooting/repair and occasional parts replacement. Non-labor assumes misc. travel expenses associate with site visits.

Appendix

The following appendix provides additional detail associated with the Pipeline Infrastructure Monitoring System (PIMS). The details identified in this section include: system description, capital and O&M cost forecasts and estimating methodologies, and system architectural and functional descriptions.

General System Description:

The Pipeline Infrastructure Monitoring System (PIMS) is a Tier 1 data collection, storage, alarm processing and data management system to collect information from methane sensor and fiber optic pipeline monitoring stations described within this filing and Appendix C and Appendix D. PIMS will provide daily sensor health/status monitoring, receive alarm information within 2-5 minutes, will report alarms to appropriate dispatch personnel for review, callout and resolution as required, and will provide system-wide viewing of daily health and alarm information. PIMS will look to interface with enhanced existing company IT systems, including SCG Advanced Meter and SDG&E Smart Meter (for methane sensor data collection), as well as GIS, SAP, ESRI and other company systems.

PIMS will include new and enhanced IT system functionality along with related data transfer interfaces to various systems that include OSI PI, SAP, GIS, ESRI, dispatch, field workforce order management systems, and SCG Advanced Meter and SDG&E Smart Meter (for sensor data collection); including the related system upgrades and system operations and management staffing to support Tier 1 system capability. This will allow for the data management and reporting for over 2,000 methane sensors and fiber optic monitors as well as provide potential expansion capability for up to 10,000 additional pipeline monitoring sensors.

PIMS is the back-office system to support the deployment of methane sensors and fiber monitoring stations to make related pipeline monitoring data and alarms available to end users to enhance the dispatch of personnel and response to potential adverse operations and emergency situations to increase public and employee safety.

B1. Capital Costs

Section B1 Capital Costs details the 5-year and multi-phased implementation of the Pipeline Infrastructure Monitoring System; its implementation schedule, capital cost summary, capital cost expenditure category breakdown, and detailed cost descriptions and expenditures.

The implementation of PIMS is a 5-year and multi-phased project by SoCalGas and SDG&E. The SoCalGas related implementation is scheduled to be performed between 2017 through 2019 and the SDG&E related implementation is scheduled to be performed between 2020 through 2021. See Table 1 – PIMS Implementation Schedule by Company.

Table 1 - PIMS Implementation Schedule by Company

PIMS Implementation Schedule					
Company	**2017**	**2018**	**2019**	**2020**	**2021**
SoCalGas					
SDG&E					

The total project capital cost is estimated to be $12.4MM. The capital cost associated with SoCalGas' based implementation is $8.5MM, with costs scheduled to be incurred between 2017 and 2019. SDG&E's implementation capital cost estimate is $3.9MM and scheduled to be incurred between 2020 through 2021. See Table 2 – PIMS Capital Cost Forecast Summary.

Table 2 - PIMS Capital Cost Forecast Summary

2016 Capital Forecast $(000s) - Direct							
Expenditure Category	**2017**	**2018**	**2019**	**Total 2017 - 2019**	**2020**	**2021**	**Total 2017 - 2021**
Labor	$0	$0	$0	$0	$0	$0	$0
Non-Labor	$495	$1,078	$6,947	$8,520	$2,114	$1,802	$12,435
Total	**$495**	**$1,078**	**$6,947**	**$8,520**	**$2,114**	**$1,802**	**$12,435**

The project capital cost forecast is broken down into four major resource categories: labor resources, hardware, software and vendor services. Capital expenditures associated with the four major resource categories are summarized below in Table 3 – PIMS Capital Cost Forecast Summary by Resource Category. Total project capital costs include: labor resources - $4.7MM, hardware - $0.3MM, software - $3.3MM and vendor services $4.1MM. Capital costs for the years 2017 through 2019 include: labor resources - $2.3MM, hardware - $0.3MM, software - $2.4MM and vendor services - $3.5MM.

Table 3 - PIMS Capital Cost Forecast Summary by Resource Category

2016 Capital Forecast $(000s) - Direct								
Resource Category	**Expenditure Category**	**2017**	**2018**	**2019**	**Total 2017 - 2019**	**2020**	**2021**	**Total 2017 - 2021**
Labor Resources	Labor	$0	$0	$0	$0	$0	$0	$0
	Non-Labor	$62	$326	$1,953	$2,341	$1,214	$1,152	$4,706
Hardware	Labor	$0	$0	$0	$0	$0	$0	$0
	Non-Labor	$0	$60	$240	$300	$0	$0	$300
Software	Labor	$0	$0	$0	$0	$0	$0	$0
	Non-Labor	$45	$105	$2,250	$2,400	$900	$0	$3,300
Vendor Services	Labor	$0	$0	$0	$0	$0	$0	$0
	Non-Labor	$388	$588	$2,504	$3,479	$0	$650	$4,129
Total	**Labor**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Non-Labor	**$495**	**$1,078**	**$6,947**	**$8,520**	**$2,114**	**$1,802**	**$12,435**
	Total	**$495**	**$1,078**	**$6,947**	**$8,520**	**$2,114**	**$1,802**	**$12,435**

The detailed project capital cost expenditures, broken down into four major resource categories, labor resources, hardware, software and vendor services are described in Table 4 PIMS Capital Cost Forecast Detail. Labor resources costs identified include the contract labor associated with the development, testing and implementation support associated with the various system upgrades, enhancements and data transfer interface development, including those associated with existing SAP, OSI PI, GIS, and Advanced Meter and Smart Meter systems. Hardware costs include those for GIS QA and Production SQL servers. Software costs include expenditures for related system software, system enhancements and licensing for related systems. Vendor services include the costs associated with professional services by the identified system and software vendors to support the development and implementation of related enhancements. See Table 4 for detailed expenditure descriptions, estimated hourly rates or units, total hours estimated or cost per unit, and annual cost allocation.

Table 4 - PIMS Capital Cost Forecast Detail

Detailed 2016 Capital Forecast $(000s) - Direct											
Resource Category	Expenditure Category	Description	Hourly Rate/ Units	Hours/ Price per Unit ($)	2017	2018	2019	Total 2017 - 2019	2020	2021	Total 2017 - 2021
Labor Resources	Labor										
	Non-Labor	SoCalGas SAP/BI/BW - Contract Labor	$100	2,480	$0	$0	$186	$186	$62	$0	$248
		SoCalGas PI - Contract Labor	$100	5,270	$62	$186	$279	$527	$0	$0	$527
		SoCalGas AM HE and NEMO - Contract Labor	$100	16,275	$0	$140	$1,488	$1,628	$0	$0	$1,628
		SDG&E SM CE - Contract Labor	$100	16,032	$0	$0	$0	$0	$802	$802	$1,603
		SDG&E AM CE to OSI PI Interface - CE Mods - Contract Labor	$100	1,000	$0	$0	$0	$0	$50	$50	$100
		SDG&E AM CE to OSI PI Interface - OSI PI Mods - Contract Labor	$100	6,000	$0	$0	$0	$0	$300	$300	$600
Hardware	Labor										
	Non-Labor	SCG GIS - Hardware (QA and Prod) - SQL Server	2	$ 150,000	$0	$60	$240	$300	$0	$0	$300
Software	Labor										
	Non-Labor	SoCalGas GIS - SQL Server Enterprise License (Prod and DR)	2	$ 100,000	$0	$25	$175	$200	$0	$0	$200
		SoCalGas GIS - ESRI Licenses (Including Additional User and PI Integrator Licenses)	1	$ 600,000	$0	$25	$575	$600	$0	$0	$600
		SoCalGas PI - PI Software	1	$ 900,000	$45	$30	$825	$900	$0	$0	$900
		SoCalGas AM Incremental Aclara Headend Licenses	1	$ 700,000	$0	$25	$675	$700	$0	$0	$700
		SDG&E SM Incremental Itron Collection Engine Licences	1	$ 700,000	$0	$0	$0	$0	$700	$0	$700
		SDG&E SM Itron CE Mods - OSI PI Mods	1	$ 200,000	$0	$0	$0	$0	$200	$0	$200
Vendor Services	Labor										
	Non-Labor	SoCalGas GIS - Senior BA	1	$ 558,000	$0	$72	$486	$558	$0	$0	$558
		SoCalGas GIS - Senior Developer	1	$ 558,000	$0	$72	$486	$558	$0	$0	$558
		SoCalGas PI Services	1	$ 1,213,000	$363	$419	$432	$1,213	$0	$0	$1,213
		SoCalGas Aclara Prof Services	1	$ 250,000	$25	$25	$200	$250	$0	$0	$250
		SoCalGas Bit Stew Services	1	$ 250,000	$0	$0	$250	$250	$0	$0	$250
		SoCalGas Upgrade AM HeadEnd to Support Tier 1	1	$ 650,000	$0	$0	$650	$650	$0	$0	$650
		SDG&E Upgrade SM Itron CE to Support Tier 1	1	$ 650,000	$0	$0	$0	$0	$0	$650	$650
Total	**Labor**				**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Non-Labor				**$495**	**$1,078**	**$6,947**	**$8,520**	**$2,114**	**$1,802**	**$12,435**
	Total				**$495**	**$1,078**	**$6,947**	**$8,520**	**$2,114**	**$1,802**	**$12,435**

B2. Capital Cost Estimation Method

The following section describes the estimation method used for developing the PIMS capital cost forecast.

(00343.003 – Pipeline Infrastructure Monitoring System) The labor costs associated with PIMS were based on recent experience by the respective IT system owners. Concurrent experience in the IT system enhancement and data transfer interface development, testing and deployment of system capabilities and system enhancements similar in size and scope were used in the cost estimation effort. Labor estimates identified include: IT professional support for SAP/BI/BW system enhancement, OSI PI system development, SoCalGas Advanced Meter and NEMO vendor system enhancement project management and validation, SDGE Smart Meter vendor system enhancement project management and validation, and SDG&E Smart Meter system to OSI PI interface development and validation. For this project, contract labor will be utilized and related costs are identified in the respective non-labor expenditure category with estimation method described below.

(00343.003 – Pipeline Infrastructure Monitoring System) The non-labor costs associated with PIMS were based on recent experience by the respective IT system owners and recent vendor system cost estimations. PIMS non-labor costs cover contract labor, related hardware, software/license and vendor/contract labor support. PIMS Non-labor costs include: GIS QA/Dev environmental hardware costs, PI system software and license costs, incremental SoCalGas Advanced Meter and NEMO license costs, incremental SDG&E Smart Meter license costs and interface to OSI PI vendor development costs, GIS SQL server and ESRI license costs, temporary Advanced Meter and Smart Meter hosting services, and Advanced Meter and Smart Meter system upgrade costs to meet Tier 1 requirements.

B3. O&M Costs

Section B3 O&M Costs details the PIMS operations and maintenance cost forecast. This section summarizes the related costs by expenditure category, by resource category, detailed expenditure and annual allocation.

The O&M cost identified for PIMS includes labor and non-labor expenditures as identified in Table 5. The O&M costs through 2022 total $6.8MM, $3.8M labor and $3MM non-labor, respectively. The O&M costs for the years 2017 through 2019 total $1.4MM, $0.7MM labor and $0.6MM non-labor, respectively.

Table 5 - PIMS Operations and Maintenance Forecast Summary

2016 Operations and Maintenance Forecast $(000s) - Direct								
Expenditure Category	**2017**	**2018**	**2019**	**Total 2017 - 2019**	**2020**	**2021**	**2022**	**Total 2017 - 2022**
Labor	$0	$186	$558	$744	$1,023	$1,023	$1,023	$3,813
Non-Labor	$0	$100	$540	$640	$840	$790	$790	$3,060
Total	**$0**	**$286**	**$1,098**	**$1,384**	**$1,863**	**$1,813**	**$1,813**	**$6,873**

The project O&M cost forecast is broken down into four major resource categories: labor resources, hardware, software and vendor services. O&M expenditures associated with the four major resource categories are summarized below in Table 6 – PIMS Operations and Maintenance Forecast by Resource Category. PIMS O&M costs through 2022 include: labor resources - $3.8MM, hardware - $0, software - $2.9MM and vendor services $0.15MM. O&M costs for the years 2017 – 2019 include: labor resources - $0.74MM, hardware - $0, software - $0.54MM and vendor services - $0.1MM.

Table 6 - PIMS Operation and Maintenance Cost Forecast Summary by Resource Category

2016 Operations and Maintenance Forecast $(000s) - Direct									
Resource Category	**Expenditure Category**	**2017**	**2018**	**2019**	**Total 2017 - 2019**	**2020**	**2021**	**2022**	**Total 2017 - 2022**
Labor Resources	Labor	$0	$186	$558	$744	$1,023	$1,023	$1,023	$3,813
	Non-Labor	$0	$0	$0	$0	$0	$0	$0	$0
Hardware	Labor	$0	$0	$0	$0	$0	$0	$0	$0
	Non-Labor	$0	$0	$0	$0	$0	$0	$0	$0
Software	Labor	$0	$0	$0	$0	$0	$0	$0	$0
	Non-Labor	$0	$0	$540	$540	$790	$790	$790	$2,910
Vendor Services	Labor	$0	$0	$0	$0	$0	$0	$0	$0
	Non-Labor	$0	$100	$0	$100	$50	$0	$0	$150
Total	**Labor**	**$0**	**$186**	**$558**	**$744**	**$1,023**	**$1,023**	**$1,023**	**$3,813**
	Non-Labor	**$0**	**$100**	**$540**	**$640**	**$840**	**$790**	**$790**	**$3,060**
	Total	**$0**	**$286**	**$1,098**	**$1,384**	**$1,863**	**$1,813**	**$1,813**	**$6,873**

The detailed PIMS O&M expenditures, broken down into four major resource categories, labor resources, hardware, software and vendor services are described in Table 7 - PIMS Operations and Maintenance Cost Forecast Detail. Labor resources costs identified include the labor associated with operating and maintaining the related systems for incremental PIMS functionality, including Tier 1 support. There are no hardware O&M costs identified for years 2017 through 2022. Software costs include expenditures for the identified system and server maintenance costs for incremental PIMS functionality. Vendor services includes the costs associated with professional services by the identified system and software vendors. See Table for detailed expenditure descriptions, estimated hourly rates or units, total hours estimated or cost per unit, and annual cost allocation.

Table 7 - PIMS Operations and Maintenance Cost Forecast Detail

Detailed 2016 Operations and Maintenance Forecast $(000s) - Direct												
Resource Category	Expenditure Category	Description	Hourly Rate/ Units	Hours/ Price per Unit ($)	2017	2018	2019	Total 2017 - 2019	2020	2021	2022	Total 2017 - 2022
Labor Resources	Labor	Existing System Modification Support (AM/SAP/PI/GIS)	$50	3,720	$0	$186	$0	$186	$0	$0	$0	$186
		SoCalGas Support for 7/24 environment (GIS)	$50	5,580	$0	$0	$0	$0	$93	$93	$93	$279
		SoCalGas Support for 7/24 environment (GIS)	$50	5,580	$0	$0	$0	$0	$93	$93	$93	$279
		SoCalGas support for PI/AES and compliances reporting	$50	29,760	$0	$0	$372	$372	$372	$372	$372	$1,488
		SoCalGas Support for PIMS AM HeadEnd	$50	7,440	$0	$0	$93	$93	$93	$93	$93	$372
		SDG&E Support for PIMS CE	$50	11,160	$0	$0	$0	$0	$186	$186	$186	$558
		SDG&E 7/24 support for Tier 1 environment (Network)	$50	5,580	$0	$0	$0	$0	$93	$93	$93	$279
		SoCalGas Support for 7/24 environment (SAP)	$50	7,440	$0	$0	$93	$93	$93	$93	$93	$372
	Non-Labor											
Hardware	Labor											
	Non-Labor											
Software	Labor											
	Non-Labor	SoCalGas GIS - SQL Server Maintenance	3	$ 30,000	$0	$0	$0	$0	$30	$30	$30	$90
		SoCalGas GIS - ESRI Maintenance	3	$ 100,000	$0	$0	$0	$0	$100	$100	$100	$300
		SoCalGas - PI Softwrare	4	$ 300,000	$0	$0	$300	$300	$300	$300	$300	$1,200
		SoCalGas AM Aclara - Incremental Maintenance	4	$ 120,000	$0	$0	$120	$120	$120	$120	$120	$480
		SoCalGas SAP Maintenance	4	$ 120,000	$0	$0	$120	$120	$120	$120	$120	$480
		SDG&E SM Itron - Incremental Maintenance	3	$ 120,000	$0	$0	$0	$0	$120	$120	$120	$360
Vendor Services	Labor											
	Non-Labor	SoCalGas GIS - Senior BA	1	$ 100,000	$0	$100	$0	$100	$0	$0	$0	$100
		SoCalGas GIS - Senior Developer	1	$ 50,000	$0	$0	$0	$0	$50	$0	$0	$50
Total	**Labor**				**$0**	**$186**	**$558**	**$744**	**$1,023**	**$1,023**	**$1,023**	**$3,813**
	Non-Labor				**$0**	**$100**	**$540**	**$640**	**$840**	**$790**	**$790**	**$3,060**
	Total				**$0**	**$286**	**$1,098**	**$1,384**	**$1,863**	**$1,813**	**$1,813**	**$6,873**

B4. O&M Cost Estimation Method

The following section describes the estimation method used for developing the PIMS operations and maintenance cost forecast.

(00343.003 – Pipeline Infrastructure Monitoring System) O&M labor costs were based on past/recent internal IT systems owner experience with similar system support as those identified for PIMS. O&M labor costs identified include those for 24/7 Tier 1 support for GIS, SAP, OSI PI, SoCalGas Advanced Meter and SDG&E Smart Meter post system enhancement and new system deployment.

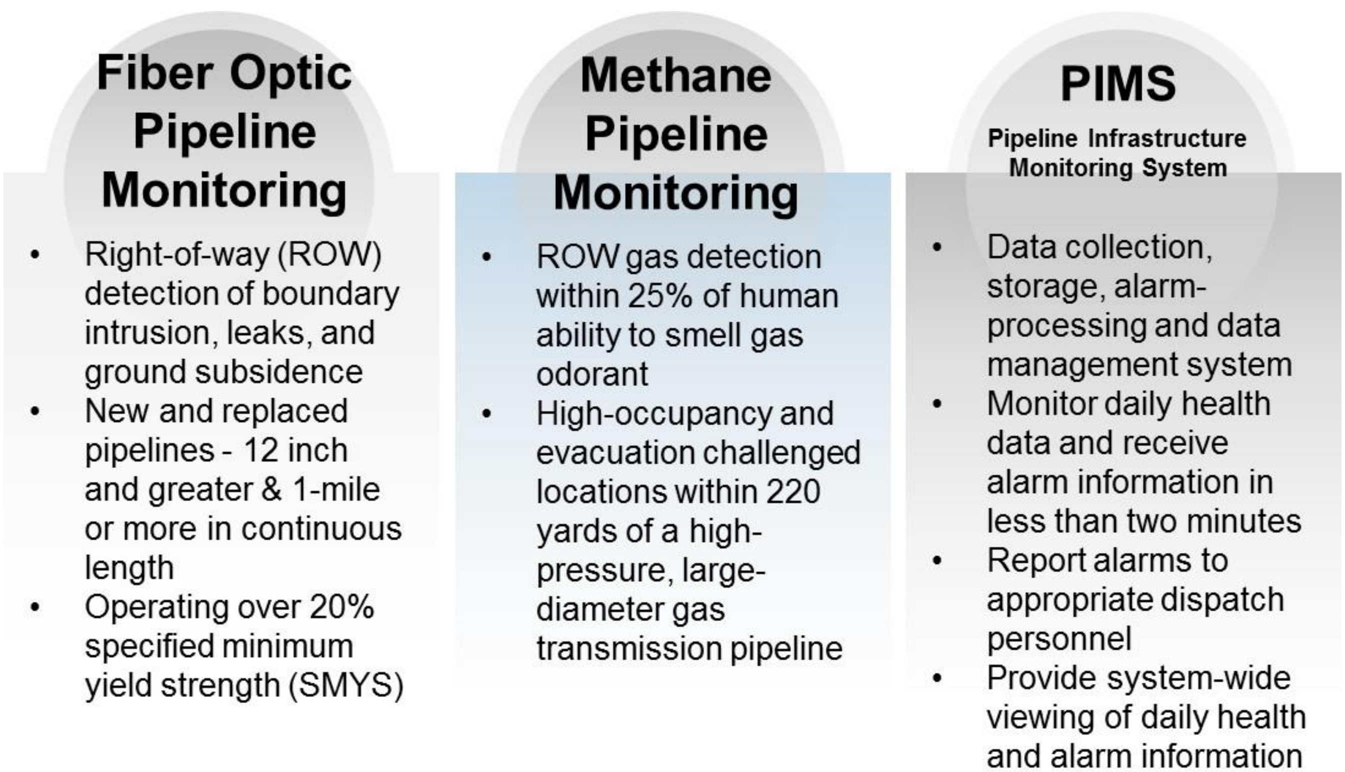
(00343.003 – Pipeline Infrastructure Monitoring System) O&M non-labor costs were based on past/recent internal IT system owner experience with similar system support as those identified for PIMS. O&M non-labor costs identified include those to provide annual vendor incremental system maintenance for GIS, SAP, OSI PI, SoCalGas Advanced Meter and SDG&E Smart Meter post system enhancement and new system implementation.

B5. Pipeline Infrastructure Monitoring System Overview and Architecture

The following section provides the PIMS overview, including related key pipeline monitoring technology areas methane and fiber optic pipeline monitoring, functional capabilities and system architecture.

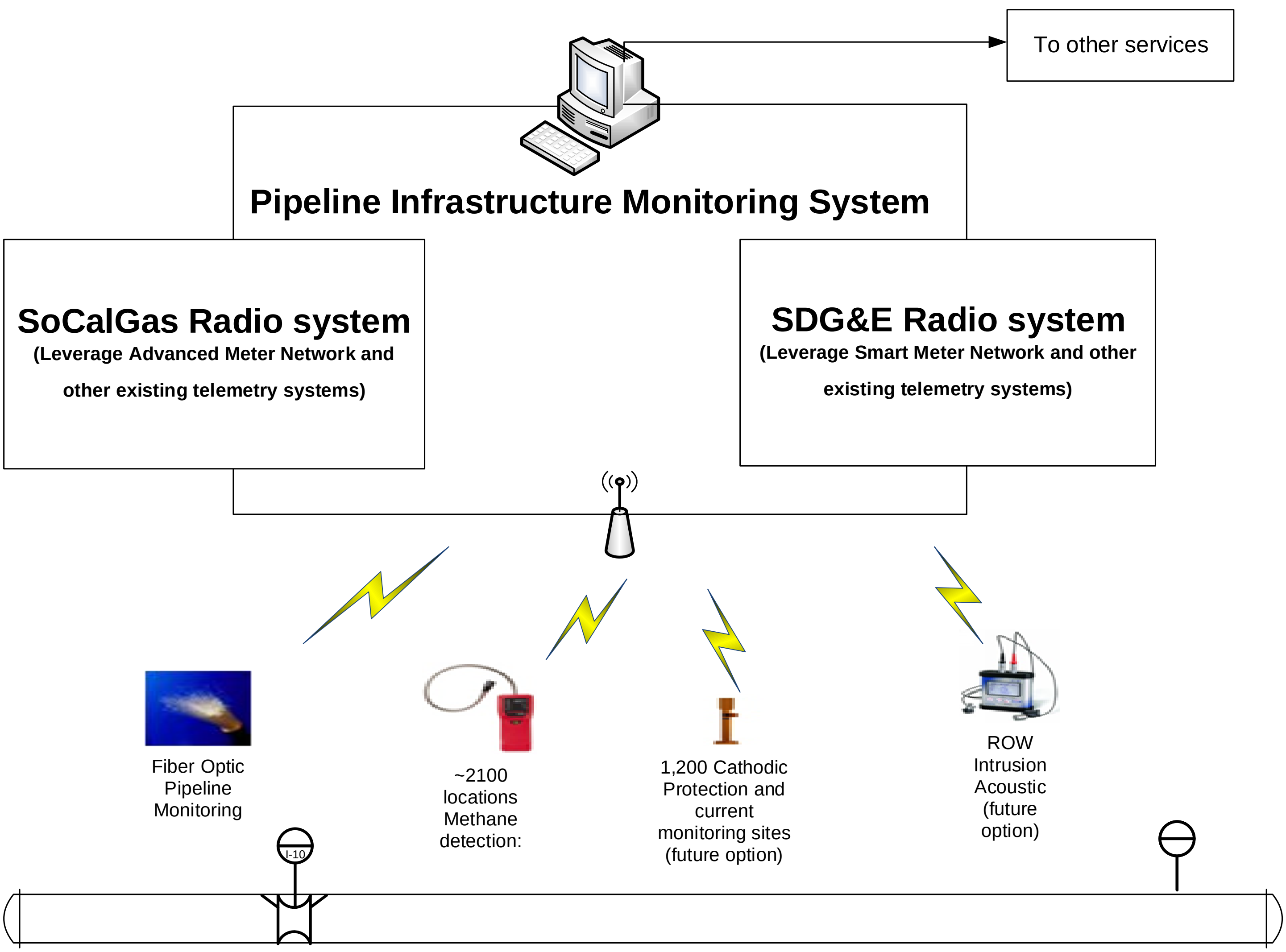
PIMS is the data collection, storage, alarm-processing and data management system associated with the deployment of pipeline monitoring technologies that include fiber optic sensing and methane sensing. The three-major key technological areas identified, Fiber Optic Pipeline Monitoring, and Methane Pipeline Monitoring and PIMS, will allow SoCalGas and SDG&E the ability to better monitor its pipelines to more quickly identify abnormal operating or emergency conditions for increased system integrity and remediation response to allow for enhanced public and employee safety. See Figure 1 – Fiber and Methane Pipeline Monitoring and Infrastructure Monitoring System Overview for details of key functionalities and capabilities.

Figure 1 – Fiber and Methane Pipeline Monitoring and Infrastructure Monitoring System Overview



PIMS is the data collection, storage, alarm-processing and data management system associated with the deployment of pipeline monitoring technologies that include fiber optic sensing and methane sensing. PIMS will interface with SoCalGas and SDG&E radio systems, leveraging Advanced Meter and Smart Meter networks, as well as existing deployed telemetry systems. These radio systems will communicate with the field deployed monitoring technologies that include fiber optics and methane sensors, and other sensors in the future that provide additional monitoring benefit. PIMS will interface with other internal systems to provide a system wide overview of our pipeline to key personnel and organizations for the management of these devices, as well as the ability to better monitor its pipelines to more quickly identify abnormal operating or emergency conditions for increased system integrity and remediation response to allow for enhanced public and employee safety. See Figure 2 – Overview of Pipeline Infrastructure Monitoring System

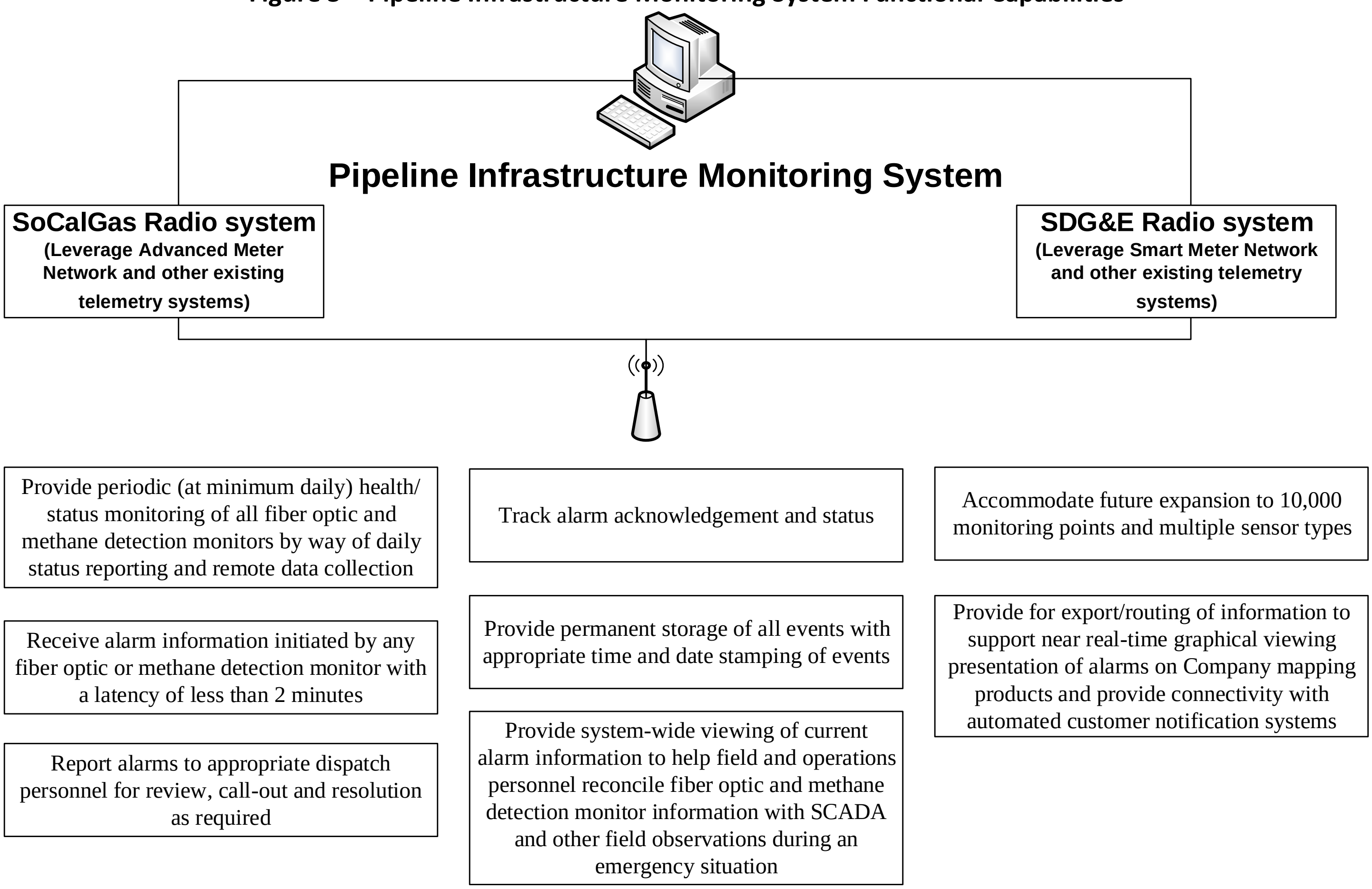
Figure 2 – Overview of Pipeline Infrastructure Monitoring System



PIMS provides key functionality to support SoCalGas and SDG&E's ability to better monitor its pipeline using various monitoring technologies, including fiber optic and methane sensing equipment. As further detailed in Figure 3, key functional capabilities include:

- Provide periodic (at minimum daily) health/status monitoring of all fiber optic and methane detection monitors by way of daily status reporting and remote data collection
- Receive alarm information initiated by any fiber optic or methane detection monitor with a latency of less than 2 minutes
- Report alarms to appropriate dispatch personnel for review, call-out and resolution as required
- Track alarm acknowledgement and status
- Provide permanent storage of all events with appropriate time and date stamping of events
- Provide system-wide viewing of current alarm information to help field and operations personnel reconcile fiber optic and methane detection monitor information with SCADA and other field observations during an emergency situation
- Provide for export/routing of information to support near real-time graphical viewing presentation of alarms on Company mapping products and provide connectivity with automated customer notification systems

Figure 3 – Pipeline Infrastructure Monitoring System Functional Capabilities



PIMS is the centralized system linking field data collection devices and networks to an enhanced data depository, enhanced event and alarm management system, enhanced visualization systems, enhanced operations based systems, enhanced asset management and work order management systems. See Figure 4 – Pipeline Infrastructure Monitoring System Architecture for further details.

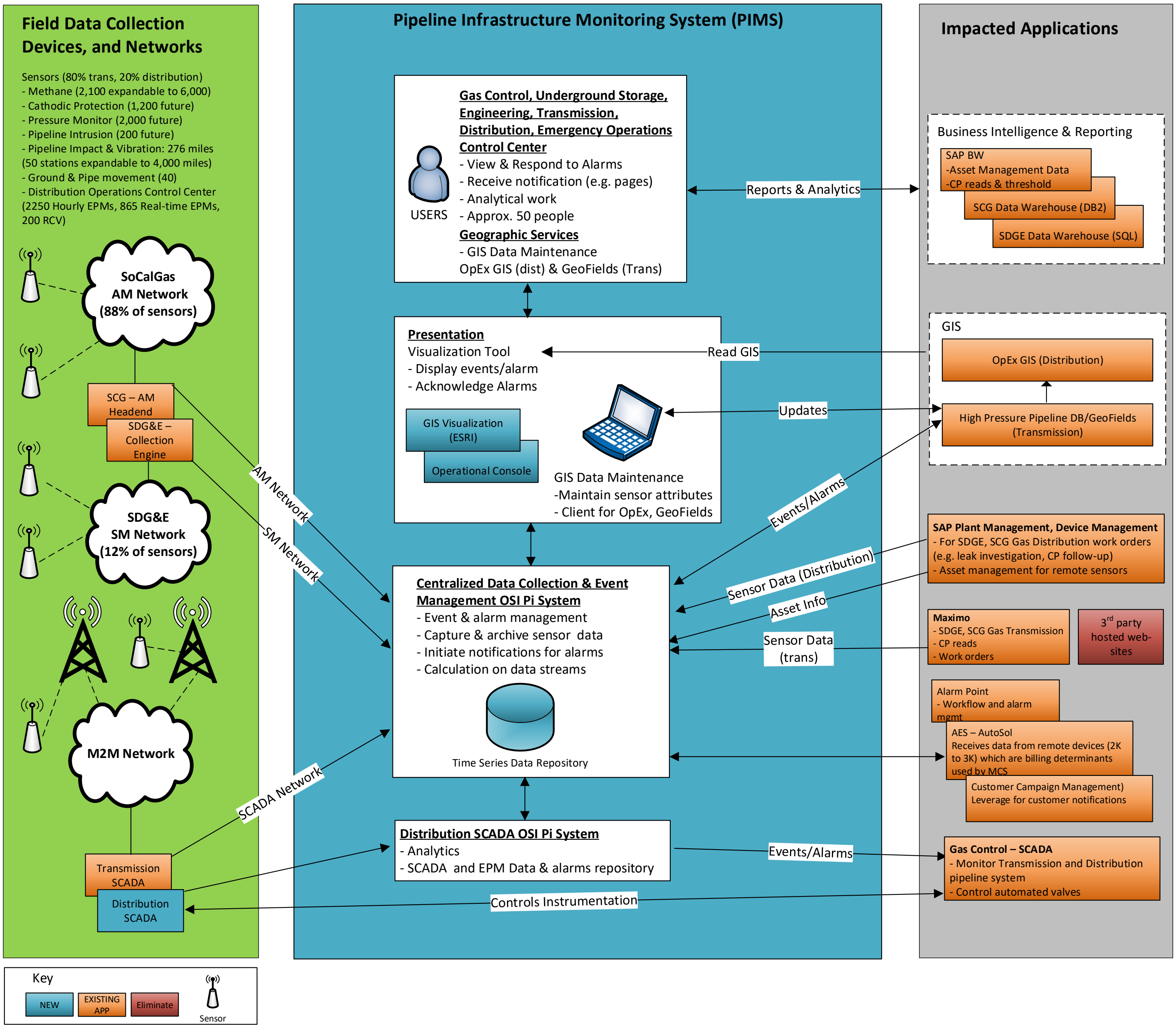
Key systems and related data transfer interfaces include:

- GIS
- OSI PI
- SAP Business intelligence and Report
- SAP Device Management and Plant Management
- SoCalGas Advanced Meter
- SDG&E Smart Meter

Key operations organizations and related functional capabilities:

- Operational Monitoring (Gas Control, Storage, Transmission, Distribution, Emergency Operations Control Center)
  - View and Respond to Alarms
  - Receive notifications
  - Analytical work
- Data Presentation (GIS, Operations Console)
  - Visualization Tool
    - Display events and alarms
    - Acknowledge alarms
- Centralized Data Collection and Event Management OSI PI System
  - Sensor data depository
  - Event and alarm collection and management
  - Initiate notifications for alarms
- Data Transfer Interfaces (Various - See Figure 4)

Figure 4 - Pipeline Infrastructure Monitoring System Architecture



Appendix

SoCalGas and SDG&E are proposing to install 2,100 methane sensors along its pipeline routes where its high-pressure pipelines 12" and greater in diameter are located in close vicinity to facilities that are high-density in occupancy, pose evacuation logistical challenges or have special implications to commerce, such as bridges and transportation centers. These sensors will be fitted with an advance meter radio-compatible module to allow for gas-in-air concentration information from the sensors to be recorded.

Below are the work papers, assumptions and figures that were used to develop the cost estimate for the proposed Methane Sensor project.

C1. Capital Costs

Deployment of the methane sensors will begin in 2018 and continue through 2021. Below you will find the approximate installation schedule for the sensors.

Figure 1: Methane Sensor Installation Schedule

CAPITAL INSTALLATION SCHEDULE							
Installation Year	2017	2018	2019	2017-19 Total	2020	2021	2017-21 Total
Units installed in year	-	525	525	1,050	525	525	**2,100**

Each methane system consists of the sensor, communications module and solar power system. Description of the capital costs to build and install a methane sensor system is shown below.

Figure 2: 2017-2021
Methane Sensor Unit Capital Costs

Unit Capital Costs			
Element	Rates / hr or qnty.	hours or qtny.	Sub total
Project Planning / Admin	$ 52.88	5	$ 264.42
Permit and site acquisition	$ 200.00	5	$ 1,000.00
Contract install / configure	$ 44.13	4	$ 176.52
Labor contract other	$ 800.00	1	$ 800.00
Contract QA / test / configure	$ 44.15	1	$ 44.15
Unit purchase	$ 2,410.00	1	$ 2,410.00
Other Materials / enclosure / mounting	$ 1,300.00	1	$ 1,300.00
Communication Device	$ 400.00	1	$ 400.00
Host system confirmation	$ 52.47	2	$ 104.94
TOTAL			**$ 6,500.03**

As mentioned above the approximate installation schedule is 525 units a year and a cost by year for these installations is calculated below.

Figure 3: 2017-2021
Methane Sensor Capital Cost By Year

Capital Cost by Year - Direct (000s)							
Installation Year	2017	2018	2019	**2017-19 Total**	2020	2021	**2017-21 Total**
Capital Cost	$300	$3,413	$3,413	**$7,125**	$3,413	$3,413	**$13,950**
Labor	$0	$0	$0	**$0**	$0	$0	**$0**
non-labor	$300	$3,413	$3,413	**$7,125**	$3,413	$3,413	**$13,950**

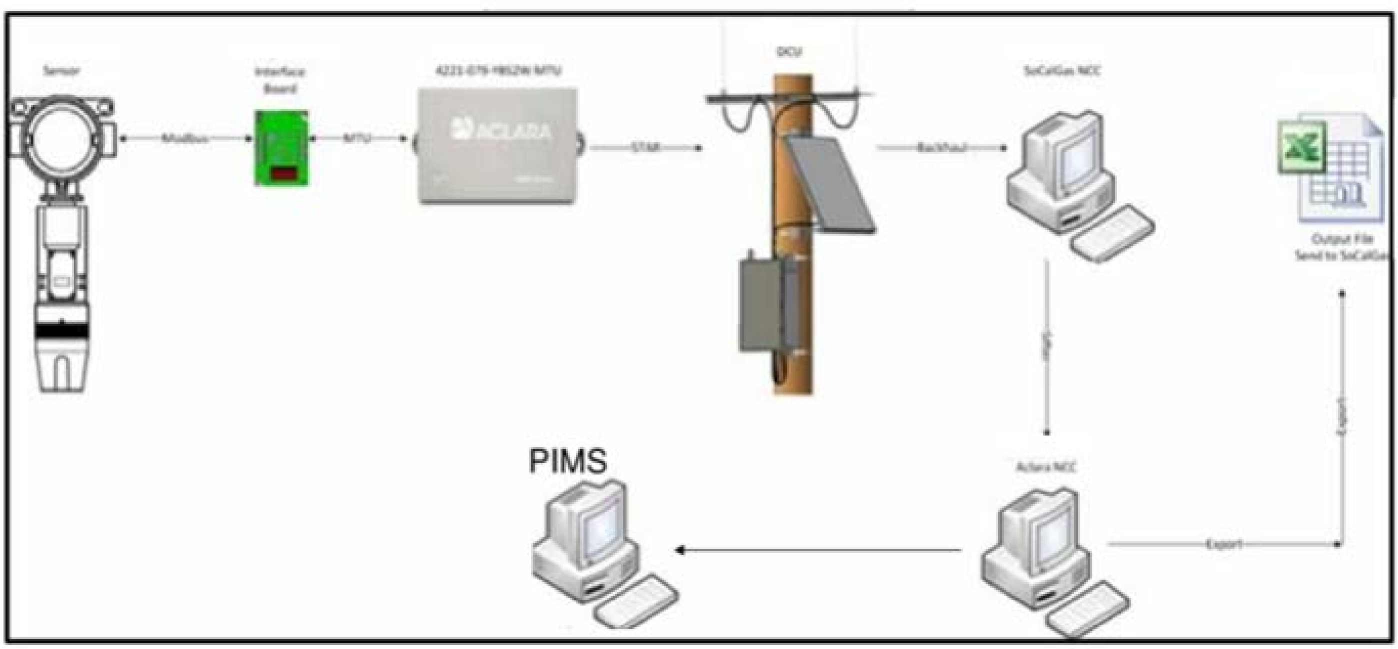
C2. Capital Cost Estimation Method

This appendix will cover the cost associated with the Methane Sensor project which will look to deploy upwards of 2,100 methane sensors along existing HCA and evacuation challenged areas. The costs that were estimated for this project were based on current labor rates and general historical costs of installing equipment in the field. In addition to the costing methods above, the information attained during pilot/test installations was also used to develop these estimates.

C3. Methane Architecture

The methane sensors will be reporting their reads making use of the company's Advanced Meter network and the data will ultimately be stored and visualized by the Pipeline Infrastructure Monitoring System(PIMS). A depiction of the planned architecture is below.

Figure 4: Methane Architecture



C4. O&M Costs

The units will have a maintenance schedule associated with them, which includes calibration, battery replacement, troubleshooting and integrity inspections. The Operations and Maintenance costs associated with these efforts are calculated below.

Figure 5: 2017-2022 Methane Unit Operation and Maintenance Costs

UNIT OPERATING AND MAINTENANCE COSTS PER YEAR.				
O&M Costs / per unit	**Rates / hrs or qnty.**	**hours or qtny.**	**Sub total**	
Union labor	$ 41.36	3	$ 124.08	
Mgmt Labor	$ 52.88	1	$ 52.88	
Union labor - Troubleshoot / Repair	$ 44.13	1	$ 44.13	
Battery	$ 35.00	1	$ 35.00	
Pole Inspection	$ 12.00	1	$ 12.00	
TOTAL			**$ 268.09**	
			$ 221.09	labor
			$ 47.00	non-labor

Below is an estimate of the maintenance that will be required for the units as they go into service. The date of commissioning is taken into account for the first and last years that are shown below for accuracy.

Figure 6: 2017-2022 Methane Unit Operation and Maintenance Costs By Year

System End point Operating and Maintenance Cost by Year - Direct $(000s)								
Year	2017	2018	2019	**2017-19 Total**	2020	2021	2022	**Total**
O&M costs	$0	$71	$211	**$282**	$352	$493	$563	**$1,971**
Labor	$0	$58	$174	**$232**	$290	$406	$464	**$1,626**
Non-labor	$0	$12	$37	**$49**	$62	$86	$99	**$346**
FTE's		1	2	**3**	2	1		**6**

Below is the incremental increase in units as they are installed and require maintenance.

O&M Maintenance Schedule							
Installation Year	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Total**
Units installed in year	-	263	525	525	525	262	**2,100**

C5. O&M Cost Estimation Method

Cost estimation for operations and maintenance labor for Methane Sensors were calculated based of the pilot/test installations. The systems have been deployed for over a year which provided enough data for our O&M forecast. Non-labor cost estimations for operations and maintenance of the Methane Sensors were calculated based off consumables and maintenance programs for the units that have been piloted/tested for over 1 year. This along with analysis of wear and tear and replacement rates for similar items within SoCalGas and SDG&E's infrastructure was how costs associated with the Methane Sensor project were derived.

Right-Of-Way Methane O&M Description

Each unit will be visited every six months on this O&M schedule. Each visit will include a calibration of the unit and replacement of the rechargeable methane sensor battery. Every other visit the Communication Module will receive a battery replacement as well. During these visits when a calibration is performed a management employee will verify that the unit reported proper levels and is in fully operational condition after the batteries are replaced. We have reserved 1 hour per year per unit for troubleshooting technical issues and repairs of defective or damaged units. We have also included time for a yearly pole inspection that will be performed during one of the 6-month interval visits which will include the verifying the integrity of the pole and all attachments. There will be a non-labor O&M inclusion of the cost of the battery unit for the Communications Module every year.

Appendix

SoCalGas and SDG&E have committed in their planning for new pipelines to route fiber optic cabling along newly-installed pipe sections which are 12" or greater in diameter and more than one mile in contiguous length. The company expects to install fiber optic monitoring stations and place into production a system when at least 5 miles of contiguous fiber is installed along a pipeline route. These stations will light the fiber and provide warning to operations and field response personnel when non-native stress, stain, impact or temperature gradients are occurring along a pipeline route. The monitoring stations will report any abnormal activity to the Pipeline Infrastructure Monitoring System (PIMS) where it can be viewed, acknowledged and resolved.

Below are the work papers, assumptions and figures that were used to develop the cost estimate for the proposed Fiber Optic Monitoring project.

D1. Capital Costs

Deployment of the Fiber will begin in 2018. Below you will find the approximate installation schedule for the fiber monitors which will be on-going.

Figure 1: Fiber Monitoring Station Installation Schedule

CAPITAL INSTALLATION SCHEDULE							
Installation Year	2017	2018	2019	2017-19 Total	2020	2021	2017-21 Total
Units Installed	-	2	2	4	2	2	8

Each fiber monitoring station will include the monitoring instruments and accompanying infrastructure. Description of the capital costs to build and install a fiber optic monitoring station is shown below.

Figure 2: 2017-2021
Fiber Monitoring Station Unit Capital Costs

Unit Capital Costs			
Element	Rates / hr or qnty.	hours or qtny.	Sub total
Project Planning / Admin	$ 52.88	225	$ 11,899.04
Permit and site acquisition	$ 3,000.00	1	$ 3,000.00
Contract install / configure	$ 41.36	80	$ 3,308.80
Contracting construction costs	$ 100,000	1	$ 100,000.00
Contract QA / test / configure	$ 44.13	242	$ 10,679.46
Unit purchase	$ 500,000.00	1	$ 500,000.00
Other Materials / enclosure / mounting	$ 60,000	1	$ 60,000.00
Communication Device	$ 2,000.00	2	$ 4,000.00
Host system confirmation	$ 50.48	75	$ 3,786.06
Host system bridge to network	$ 44.13	75	$ 3,309.75
TOTAL			$ 699,983.11

As mentioned above the approximate installation schedule is 2 units a year and a cost by year for these installations is calculated below.

Figure 3: 2017-2021
Fiber Monitoring Station Capital Cost By Year

Operating Cost by Year - Direct $(000s)							
Installation Year	2017	2018	2019	**2017-19 Total**	2020	2021	**2017-21 Total**
Capital Cost	$0	$1,400	$1,400	**$2,800**	$1,400	$1,400	**$5,600**
Labor	$0	$0	$0	**$0**	$0	$0	**$0**
non-labor	$0	$1,400	$1,400	**$2,800**	$1,400	$1,400	**$5,600**

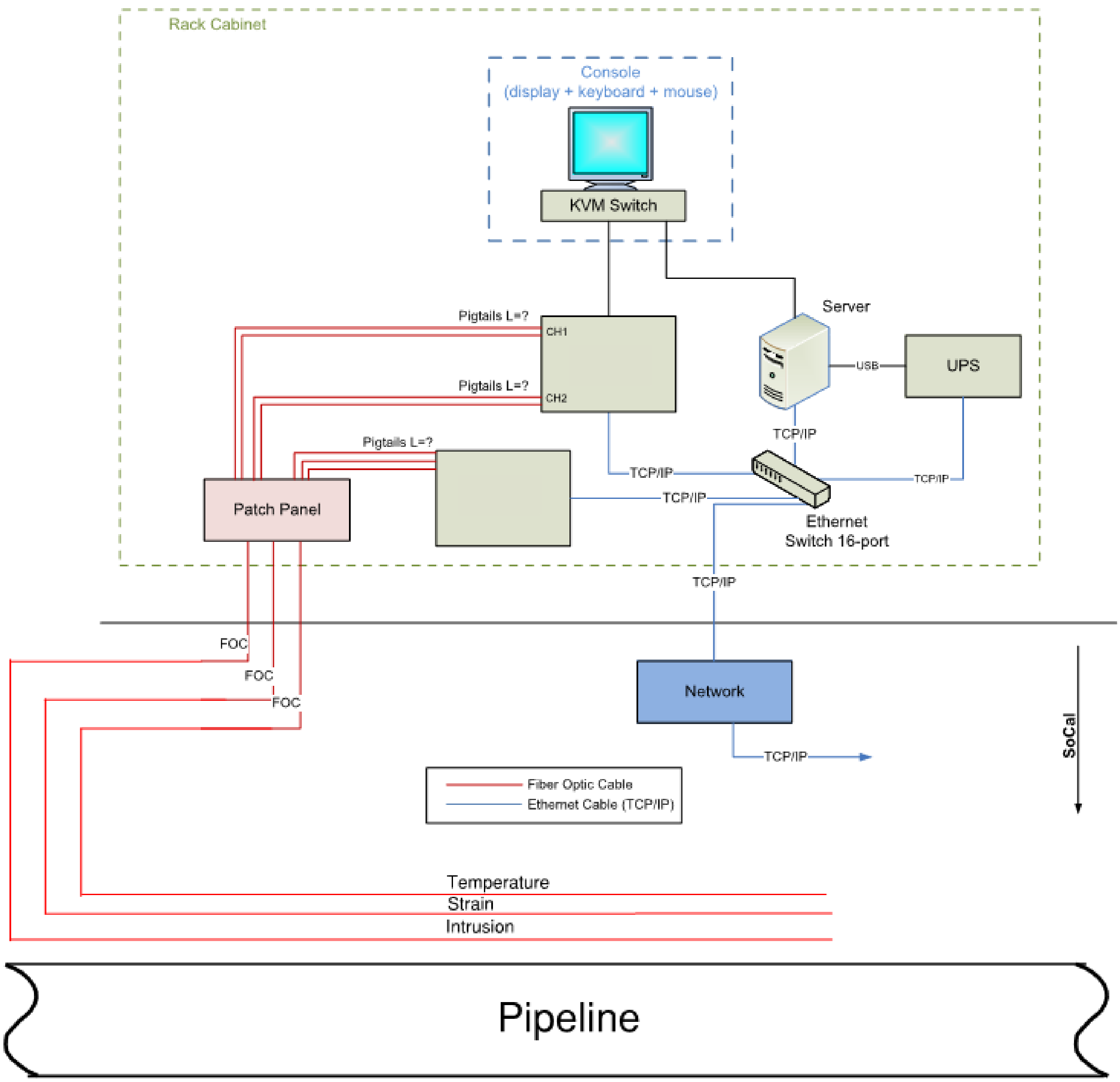
D2. Capital Cost Estimation Method

The costs that were estimated for this project were based on current labor rates and general historical costs of installing equipment in the field. In addition to the costing methods above, the information attained during pilot/test installations was also used to develop these estimates.

D3. Fiber Architecture

In Figure 4 you will find the architecture of the fiber optics monitoring station which includes the instruments and servers within an air conditioned building. The station is then connected to the fiber cables laid above the gas pipeline shown below.

Figure 4: Fiber Monitoring Station Architecture

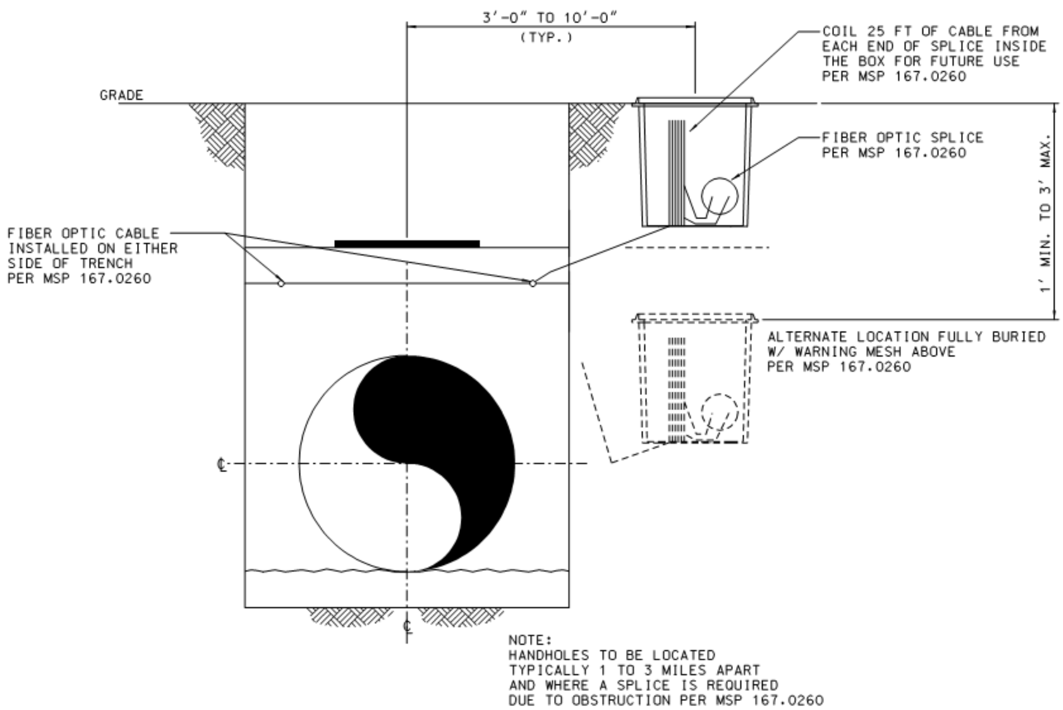


Below you will find the typical configuration of a fiber monitoring station rack which holds the servers, instruments and uninterruptable power supply.

Figure 5: Fiber Monitor Rack Drawing

In Figure 5, the company standard detail for fiber installation along a pipeline route is show. The detail also shows the placement of access vaults for future repairs or extensions of the fiber installation.

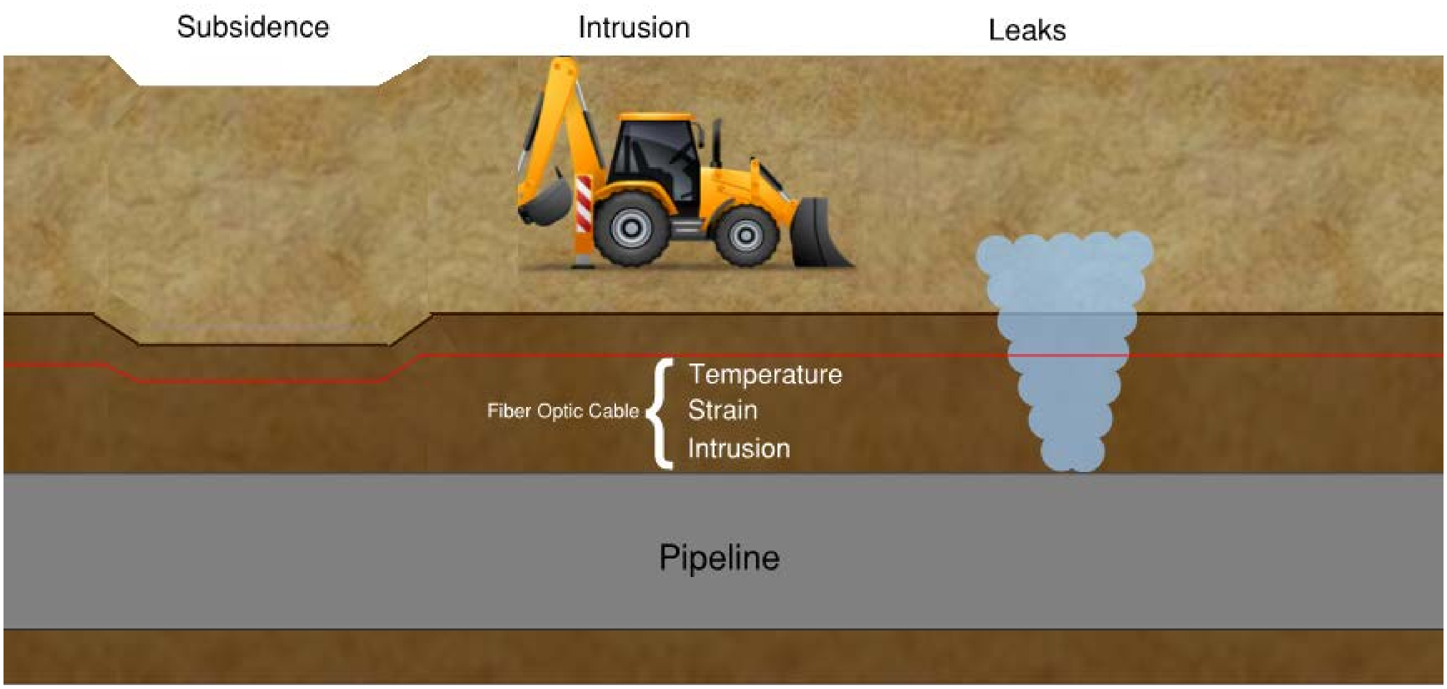
Figure 6: Fiber Installation Details



HANDHOLE BELOW GRADE

Below you will find depicted the capabilities of the fiber optics monitoring system in Figure 6.

Figure 7: Fiber Capabilities



D4. O&M Costs

The units will have a maintenance schedule associated with them, which includes calibration, battery replacement, troubleshooting and integrity inspections. The Operations and Maintenance costs associated with these efforts are calculated below.

Figure 8: 2017-2021 Fiber Monitor Unit Operation and Maintenance Costs

UNIT OPERATING AND MAINTENANCE COSTS PER YEAR				
O&M Costs / per unit	**Rates / hrs or qnty.**	**hours or qtny.**	**Sub total**	
Union labor - maintenance	$ 44.13	45	$ 1,985.85	
Mgmt Labor - project management	$ 52.88	60	$ 3,173.08	
Union labor - troubleshoot / repair	$ 41.36	30	$ 1,240.80	
Non-labor - misc materials / exp	$ 500.00	1	$ 500.00	
Battery Replacement	$ 1,500.00	1	$ 1,500.00	
Utility power	$ 20.00	12	$ 240.00	
Monitoring Fee	$ 150.00	12	$ 1,800.00	
Service Contract	$ 40,000.00	1	$ 40,000.00	
TOTAL			**$ 50,439.73**	
			$ 6,399.73	labor
			44,040.00	non-labor

Below is an estimate of the maintenance that will be required for the units, including health checks and yearly maintenance visits.

Figure 9: 2017-2021 Fiber Monitoring Unit Operation and Maintenance Costs By Year

System End point Operating and Maintenance Cost by Year - Direct							
Year	2017	2018	2019	**2017-19 Total**	2020	2021	**2017-21 Total**
O&M costs	$0	$101	$202	**$303**	$303	$404	**$1,009**
Labor	$0	$13	$26	**$38**	$38	$51	**$128**
Non-labor	$0	$88	$176	**$264**	$264	$352	**$881**

D5. O&M Cost Estimation Method

Cost estimation for operations and maintenance labor for the fiber optics monitoring stations were calculated based of the pilot/test installations. The systems have been deployed for over a year which provided enough data for our O&M forecast. Non-labor cost estimations for operations and maintenance of the fiber optics monitoring stations were calculated based off consumables and maintenance programs for the units that have been piloted/tested for over 1 year. This along with analysis of wear and tear and replacement rates for similar items within SoCalGas and SDG&E's infrastructure was how costs associated with the Fiber Optics project were derived.

Fiber Optics Right-Of-Way Monitors O&M Description

Each unit will be visited physically once a year by management employee, union employee and contractor to perform yearly maintenance of the system which includes air filter cleaning, fiber connector cleaning and data housekeeping. During this visit the overall health of the system will be checked on both a physical layer and software layer. The union employee will be present at all times during this visit to a secure transmission facility in case of any irregular activity. In addition to the maintenance visit, an engineering employee will be logging into the system twice a year to configure new baselines and perform analysis on alarm levels based on the noise floor at that time. The Network Operations Center will be involved in any remote connections to the system by the vendor and they will monitor the activity during the time of their session, this is planned to happen a few times a year and has been accounted for. These sites will be across the territory and will be distances of above 200 miles from company headquarters and we have accounted for mileage on the maintenance and repair trips. This equipment will cause an increase in usage of utility power and cellular communications at each of these sites and the associated costs have been accounted for as well. We have also included vendor maintenance and support costs in the operating and maintenance estimates. Uninterruptable power supply batteries will also be replaced every 3 years and this was also included with its associated labor costs in the estimate.