The World Market for Substation Automation and Integration Programs in Electric Utilities: 2005-2007

EXECUTIVE SUMMARY

NORTH AMERICAN MARKET

September 2005

by

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Ellicott City, Maryland 21042

Determination of Whether A Substation Automation Strategy Is Currently in Place among North American Electric Utilities

The study has found that 76% of the utility respondents indicated having a substation automation and integration strategy in place. Eighty-three percent of the respondents indicated having a substation automation and integration program underway by August 2005.

Ranking of Importance of "Potential Obstacles" to Implementing Substation Automation for *New* and Existing *(Retrofit*) Substations:

New Substations - the lack of appropriate communications technology (substation to substation) and the fact of not enough skilled internal staff were leading "potential obstacles" to substation A&I program investments. Lack of funding was especially important for investor-owned utilities and for Canadian utilities.

Existing (Retrofit) Substations - for retrofit substations, the biggest obstacles reported were lack of funding and benefits/costs perceptions. This finding was reported by IOUs, public power utilities and Canadian utilities. Cooperatives were more likely to be concerned with the benefits, but concerns over substation communications were strong as well.

Spending Estimates for New and Retrofit Substation Automation Programs between 2005-2007:

The group reported significantly increased plans for spending on substation automation-related programs from earlier studies. The total of $78 million is more than double the amounts reported as available for substation automation spending in the 2002 study. Again this year, IOUs dominated spending plans, but the other groups also plan to spend in the millions of dollars ranges.

Plans for spending on retrofit substations was equally strong, with $77 million budgeted and even higher amounts planned for the next five years (192 million dollars) than for new substations over the same five year period (177 million dollars).

Approach to Obtaining Substation Automation Systems and Equipment:

Forty-six percent indicated that they bought from Best in Class suppliers of individual substation equipment for A&I programs. Nine percent indicated purchases only from larger suppliers active in the market. Over one third (34%) reported buying equipment only, and then integrating the equipment internally. Thirteen others reported use of consultants to develop a comprehensive substation A&I plan. Only three reported purchasing directly from substation system integrators.

Current and Planned Use of Protocols *Within* the Substation:

Just about three quarters of the 99 North American utility respondents cited current use of DNP3.0 (Serial) and nearly one quarter indicated use of DNP 3.0 (LAN). None of the current international standard IEC protocols was cited by any utilities as being in use by August 2005. There were some plans to use IEC 61850 by 2007 (six percent). Modbus and Modbus Plus remain strong, with 37% citing some use of Modbus (serial) and 22% citing use of Modbus Plus.

Current and Planned Use of Protocols *from* the Substation to An External Host:

One half of the group was using DNP 3.0 and 22% had moved on to DNP 3.0 LAN. There was only minimal use of any other protocol listed, while several write-ins of older legacy proprietary protocols were still popular. Among these were: ACS, CDC, Conitel, L&G/Telegyr, QUICS and Tejas/Valment/Metso protocols. Current users of DNP serial were by and large planning to migrate to the LAN version of DNP.

Encryption of Protocols: Usage and Plans:

Eighty-nine of 95 officials indicated that they were not encrypting data transmissions (or protocols) used in substation communications.

Types of Protocols in Use:

Officials indicated that for the most part (81%) they were using standard versions of protocols, while 18% were using both tailored and standard versions of communications protocols.

Current and Planned Choices of Physical Links and Media *from* the Substation to External Hosts/Networks:

Over one half of the respondents indicated at least some use of fiber or synchronous optical network linkages. Forty-three percent continue to rely on leased lines, while 40% cited use of MAS radio, and 38% were using microwave. Importantly, IOUs are the subgroup most likely to use at least some telephony in their comms media mix. IOUs were also planning to use some frame relay and microwave, more than other subgroups.

Alternative Methods of Communications with Remote Sites in the Event of Loss of the Routine Communications Pathways.

Telephony approaches to backup or alternative communications to critical remote sites continue in importance. More than 30 (about one third of the group) officials cited no backup available if routine communications pathways were lost.

Number of Ethernet Ports Available in a Typical Substation:

Thirty-six officials indicated that no Ethernet ports were typically available in their T&D substations. Of those who did indicate having such ports available, the nominal midpoint was 8 ports, with a few having either 24 or 48 ports.

Security of Ethernet Ports:

Eighty percent of the respondents to this question indicated that their substation Ethernet ports were in fact secured. Two thirds of those who had indicated secure ports stated that they were secured via port security methods, while 19 said "other" methods were being used. Other methods included: NMS, authentication, OP addressing, firewalls, and passwords.

Number of Simultaneous Wireless Connections Allowed in the Substation:

Forty-four of 74 respondents indicated that they allow "no" simultaneous wireless connections in their substations. Fifteen said that one or two were permitted. The need for simultaneity seems to be more apparent when the substation data is required by two or more entities (utilities, utility-ISO/RTO, utility engineering/utility operations).

Use of Modems in the Substation Communications Schema:

Twenty-two percent of the 97 respondents indicated no use of modems. This was especially likely among public power utilities. IOUs were very likely to be using at least some modems. Most of the modem users were using at least some hardwired modems (97%), while 12% were also using some cellular modems and seven percent were using other forms of wireless modems.

Security of Remote Connections (Such as Modems, Wireless Connections):

Fifty-nine percent of the 96 respondents to this question indicated that their remote connections were secured, while 41% admitted using unsecured connections. Only 37 of the 57 users who cited having secure connections indicated having ALL of their connections secured.

Communications in Remote Connections Protected (Encrypted):

Only 19% of the 96 responding utility officials indicated that they encrypted or otherwise protected communications in remote connections. Eighty-one percent admitted to using unsecured communications in their remote connections.

Use of Routable Paths to the End Devices:

Only one third of the utilities were making use of routable paths to their end devices. Most (77%) of those utilities using routable paths were also monitoring the pathing.

Current and Planned Choice of Communications Architecture *within* and *to* the Substation:

Within the Substation - By and large, serial links continue to be widely used in North American substations in mid-2005, regardless of the type of utility operating the substation. LAN usage is found in substations operated by 42% of the respondent sites. There was minimal use of and minimal plans for VSATs and WANs in the substations of North America, based on the study findings.

To the Substation - Current communications architecture to and from the substation was still likely to be serial links, but the use of WANs has increased from earlier Newton-Evans studies. Plans call for even more use of WAN architecture over the next few years, followed at a distance by increased uses of LANs.

Current and Planned Handling of Primary Substation Information Processing Tasks "Inside the Fence":

By mid-2005, smart RTUs were prevalent in North American substations, with dumb RTUs next. PLC use was acknowledged by 26% of the group. PC use in substations had reached 20%. Dumb RTUs were still in use at least in some substations among 53% of Canadian utilities and one half of the responding electric cooperatives.

Current and Planned Connectivity of Substations to Other Utility Systems:

Across the industry, utility SCADA or EMS systems led the way with 93% indicating links from substations back to these systems. Smart feeder devices were mentioned by 41% of the group, and protection engineering by 36%. Plans centered around establishing some degree of linkage capability from the substation to the corporate WAN, to GIS systems and to trouble call, protection engineering and maintenance, but all of these plans were below 20% mention rates.

External Assistance Needed for Various Substation Automation Activities:

This question was asked to gain insight into what types of services could be provided by third-party firms, whether they are specialist service firms, or equipment or systems suppliers, into the substation marketplace. By mid-2005, utilities were indicating a need for training assistance (42%), for IED configuration support (34%) and for engineering drawing support (31%). These rates exceed the demand seen in earlier Newton-Evans studies.

Level of Current and Planned Automation Indicated for Transmission and Distribution Substations:

The respondents included 81 transmission utilities and 95 utilities with distribution substation assets. Together, these utilities accounted for about 35% of T&D substations in North America. Respondents were requested to indicate whether their transmission and distribution substations were not at all automated, or whether they had one of four stages of automation. These four stages were identified as:

Stage 1 - IED implementation; substation has IEDs installed - no integration
Stage 2 - IED integration; installed IEDs are integrated, utilizing 2-way communications capability and NO substation LAN
Stage 3 IED integration; installed IEDs are integrated, utilizing 2-way communications capability and/or substation LAN
Stage 4 - Applications are run at the substation level to automate various substation functions

In this study, 7,031 substations were classified by respondents as transmission voltage substations. Another 18,938 units were classified as distribution voltage substations. There were plans in place to construct 223 new transmission voltage substations over the 2005-2007 period, and an additional 725 new distribution class substations were also planned.

Specific Equipment Types in Use and Planned for Use in Conjunction with Substation Automation Programs:

Transmission Substations - Seventy-five utility officials took the time to indicate which of 15 specific equipment types were or were planned to be part of their utility's transmission substation-wide automation programs. RTUs, digital relays, redundant protection schemes and digital fault recorders were all indicated by more than one half of the respondents as component parts of their utility substation automation programs.

Distribution Voltage Substations - Ninety-two officials provided information on the equipment types being used or planned for use in conjunction with distribution substation automation programs. In distribution substations, RTUs, digital relays and LTC transformers were indicated as the most widely used components in automation and integration programs.

Voltage Ranges Used to Power Substation Automation Equipment:

Respondents were requested to indicate the most used voltage ranges to power substation automation equipment in the substations operated by the utilities. Range choices were: 110 or 200 VAC, <24 VDC, 24 to 48 VDC, 72 to 125 VDC, and >125 VDC.

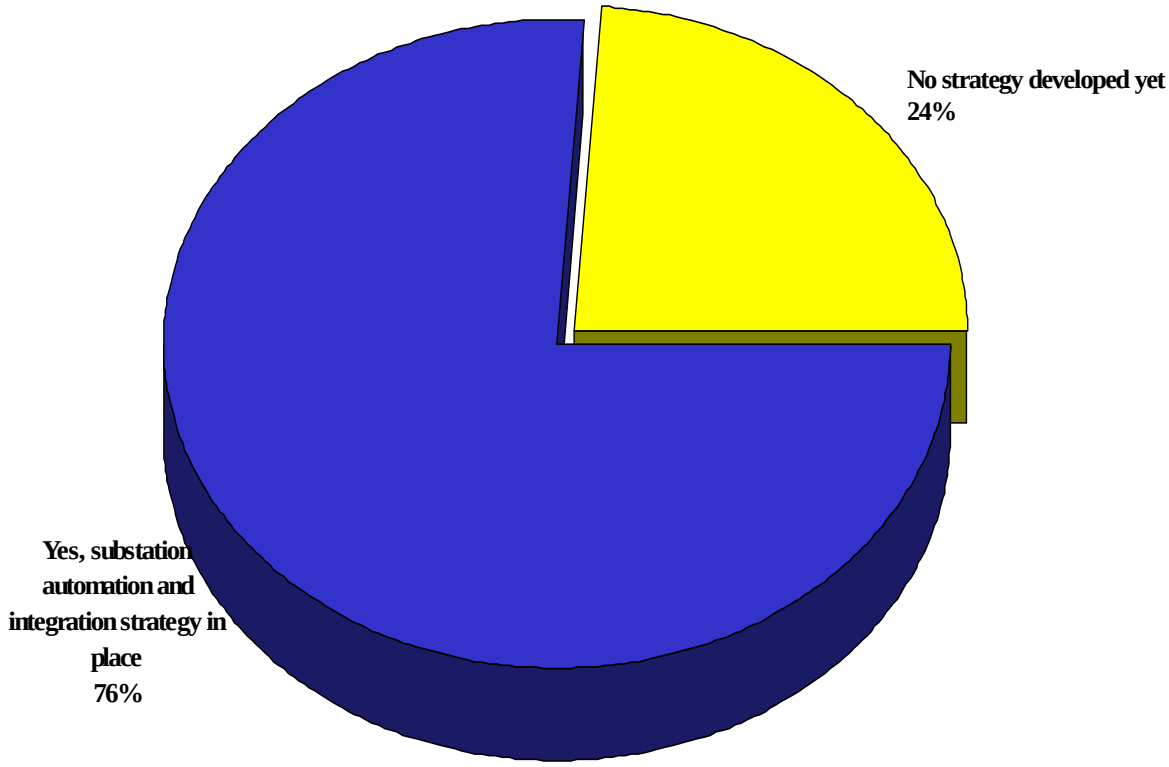
Based on 99 utility responses, the most frequently used voltage ranges used to power T&D substation automation equipment were: 72-125 VDC followed by 24-48 VDC.

Current and Planned Use of Substation Security Measures:

Seven optional responses were listed in this question on substation security methods and practices. Utilities were asked to indicate whether they were using or had plans to use any of the following: encryption of RTU communications, password protection for IEDs, video camera surveillance, improved intrusion detection, secure facilities, eye/fingerprint identification, and limited accessibility to substation-related keys.
Three security measures stand out from the group as having been implemented by mid-2005. These included two physical measures and one cyber measure. First, limited accessibility to substation-related keys; secondly, secure substation facilities (locked building and enclosures); and thirdly, password protection for access to intelligent electronic devices.

Plans for adding additional security by 2007 include: improved intrusion detection, deo camera surveillance and encryption of RTU communications.

Substation Automation and Integration Strategy Currently in Place



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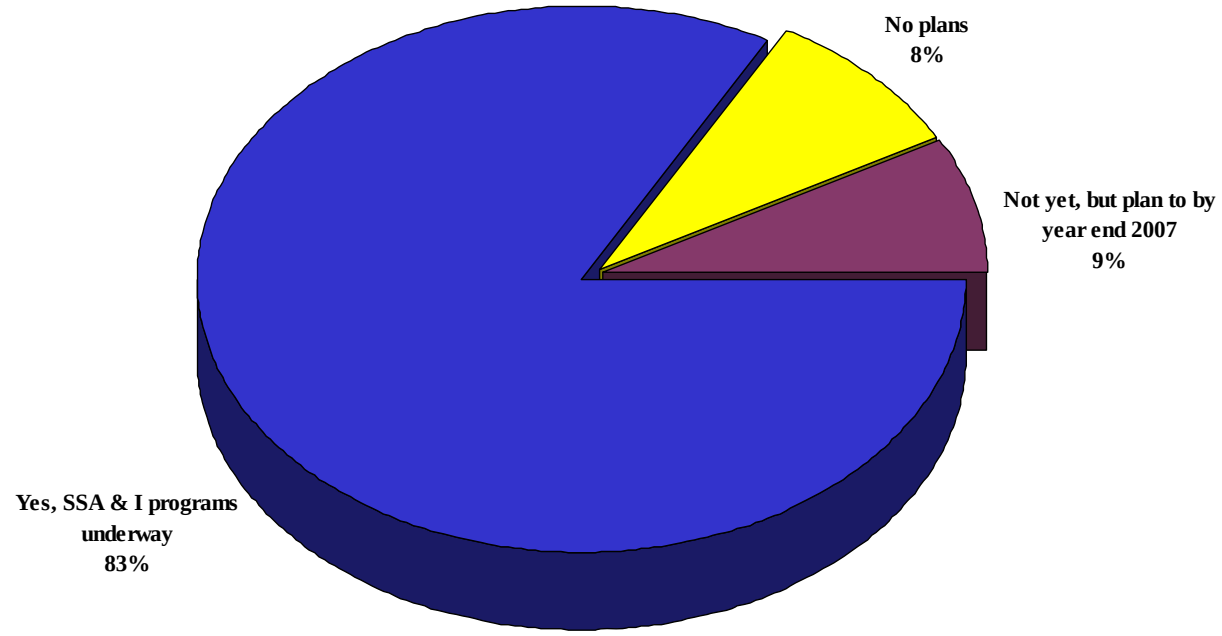
Substation Automation and Integration Programs Underway



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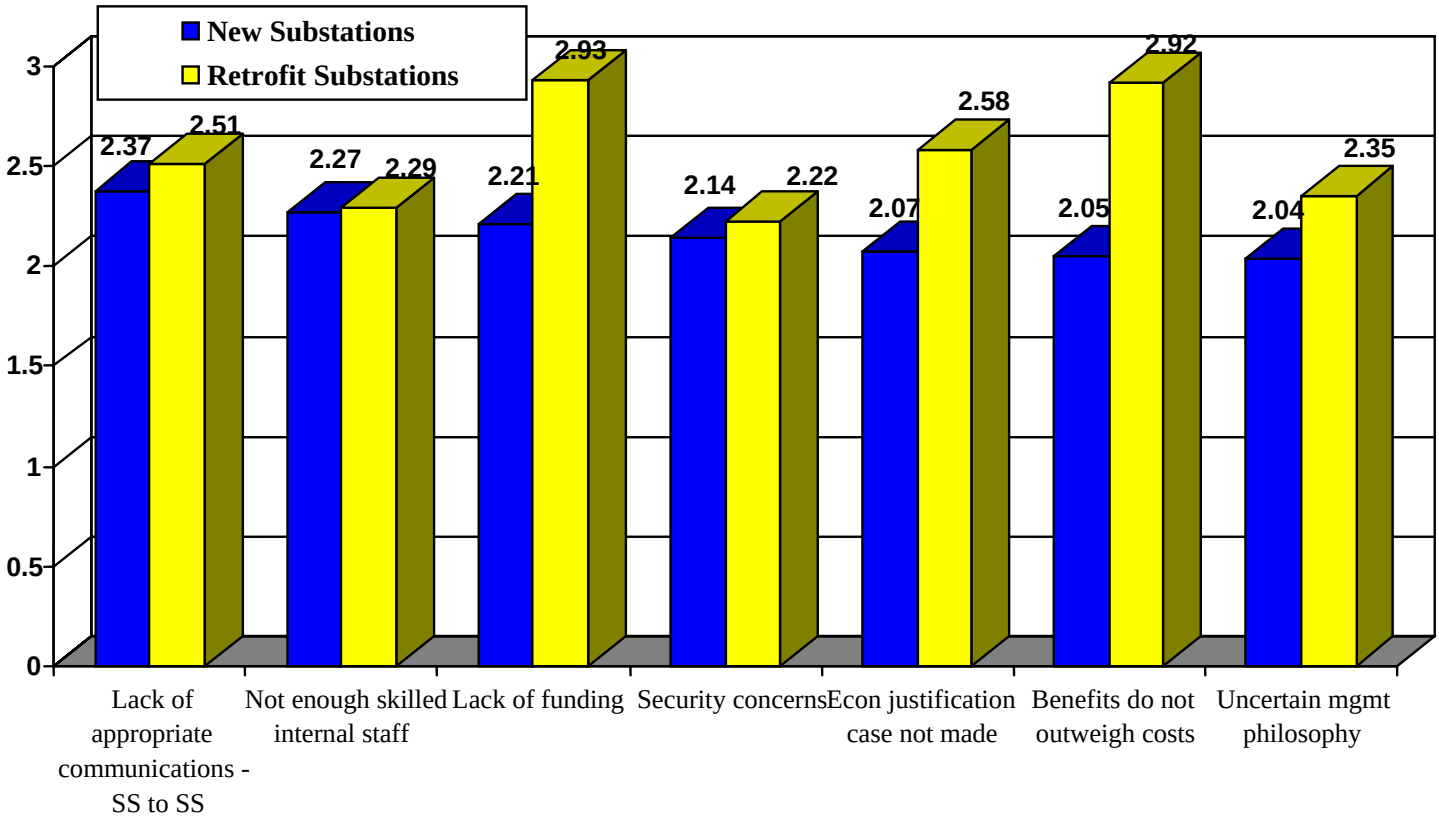
Ranking of "Potential Obstacles" to Implementing Substation Automation through Year-End 2007

(where 1 = doesn't stand in our way to 5 = formidable obstacle)



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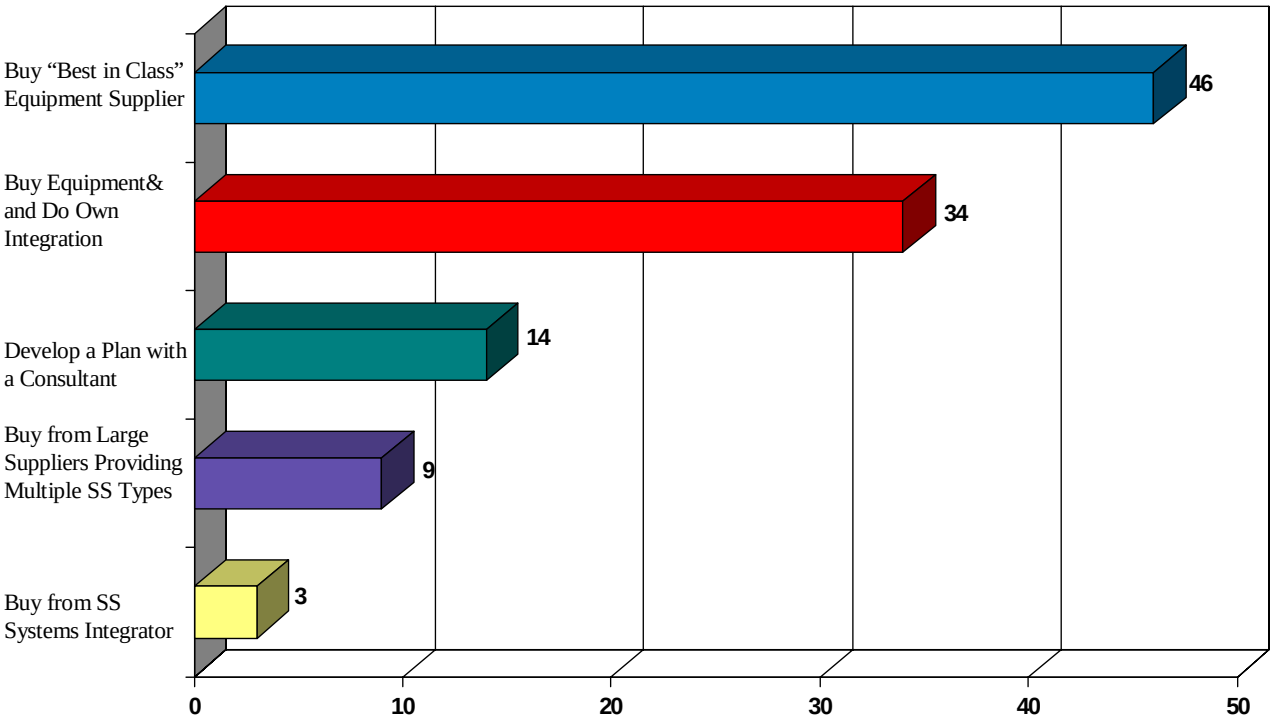
Utility Approach for Obtaining Substation Automation Systems and Equipment



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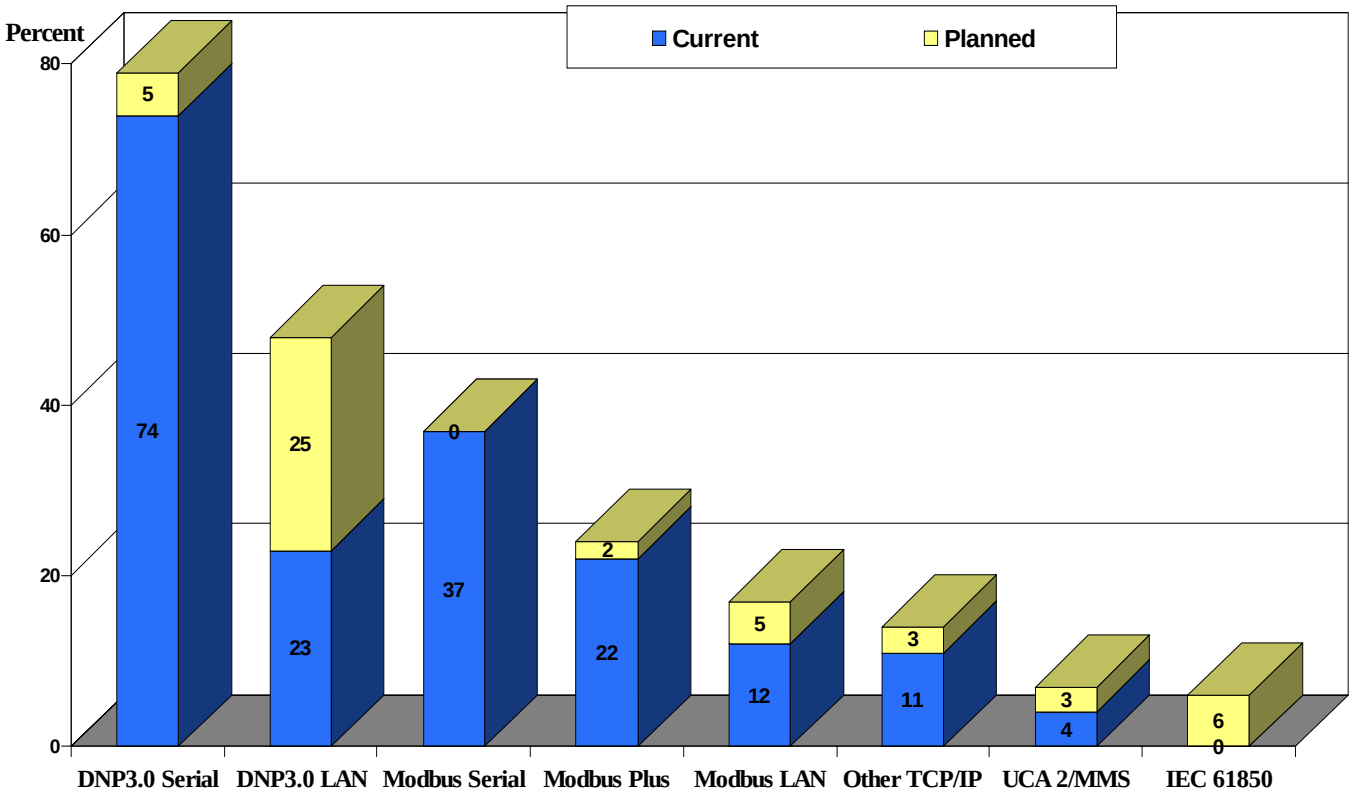
Current/Planned Use of Protocols
Within the Substation



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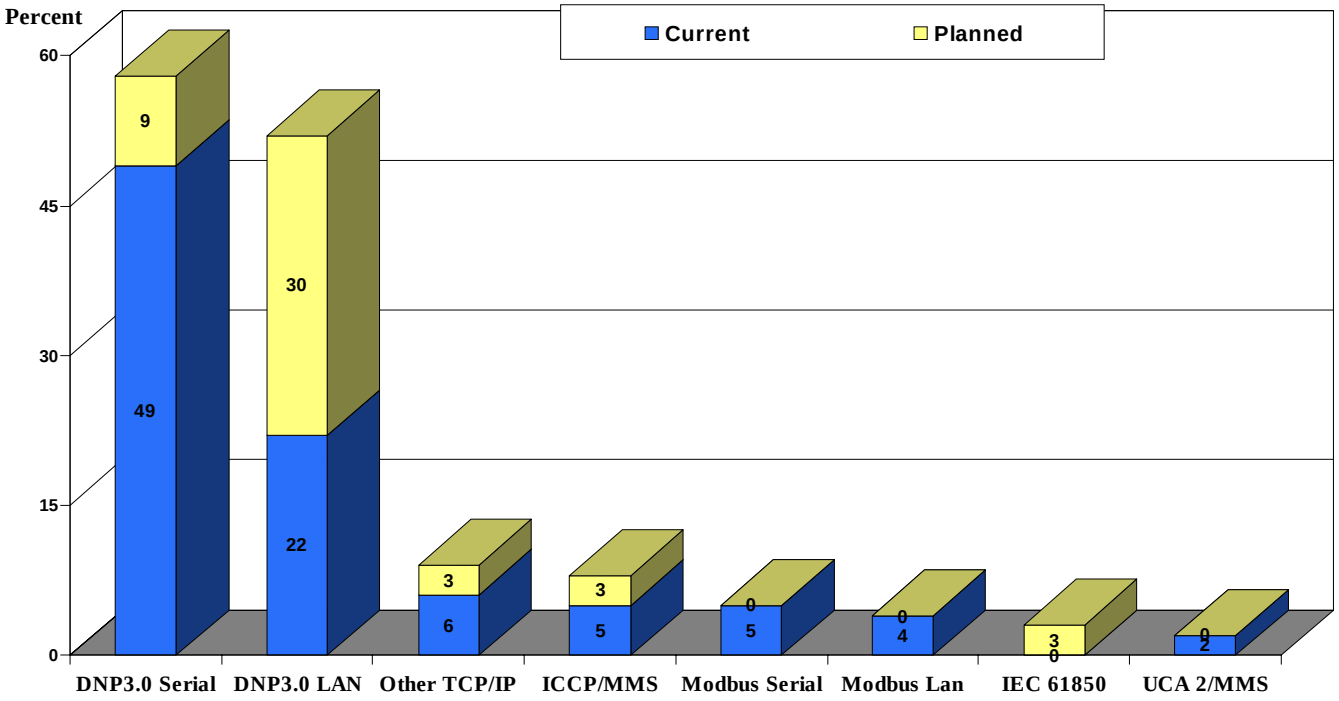
Current/Planned Use of Protocols
from the Substation to External Host/Network



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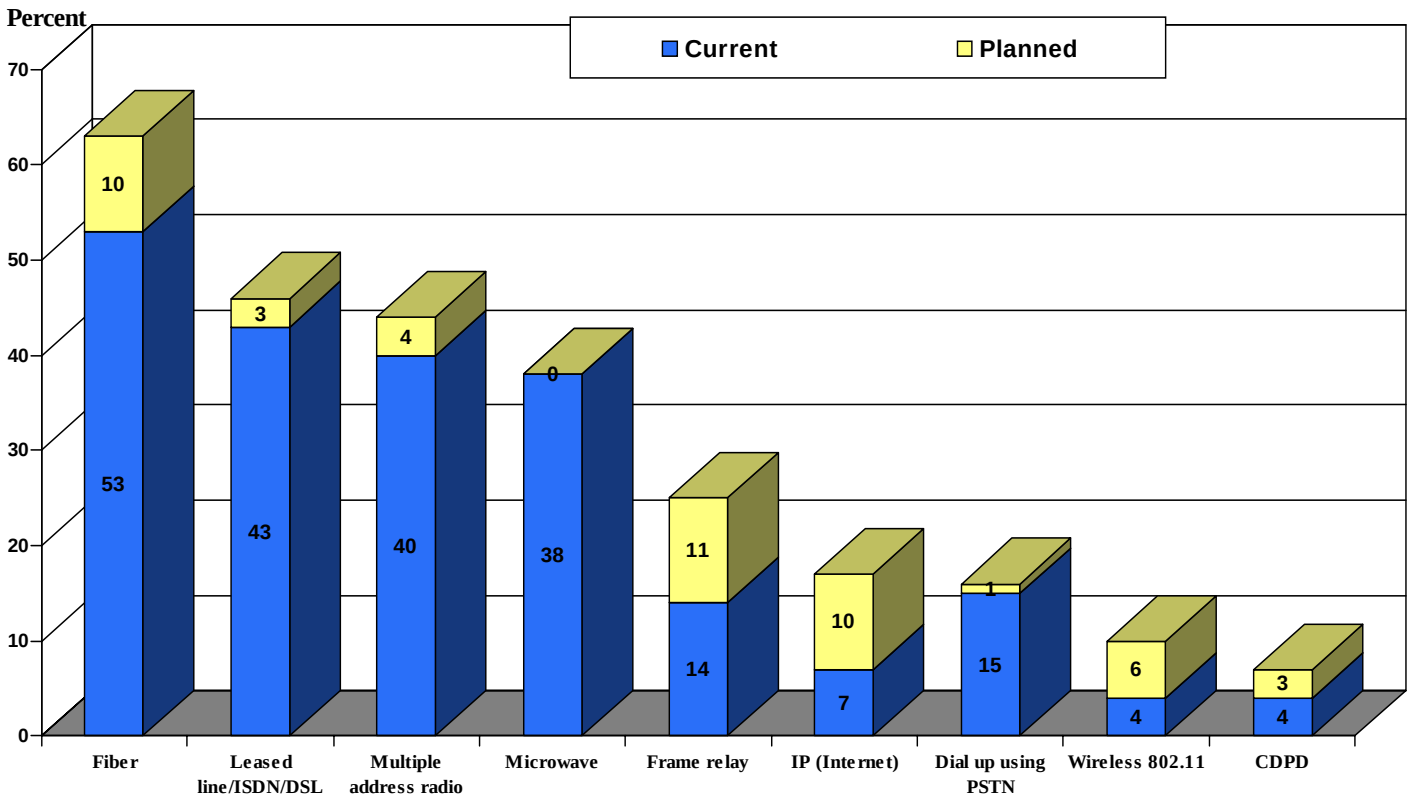
Current/Planned Use of Physical Links/Media *from* the Substation to External Host/Network



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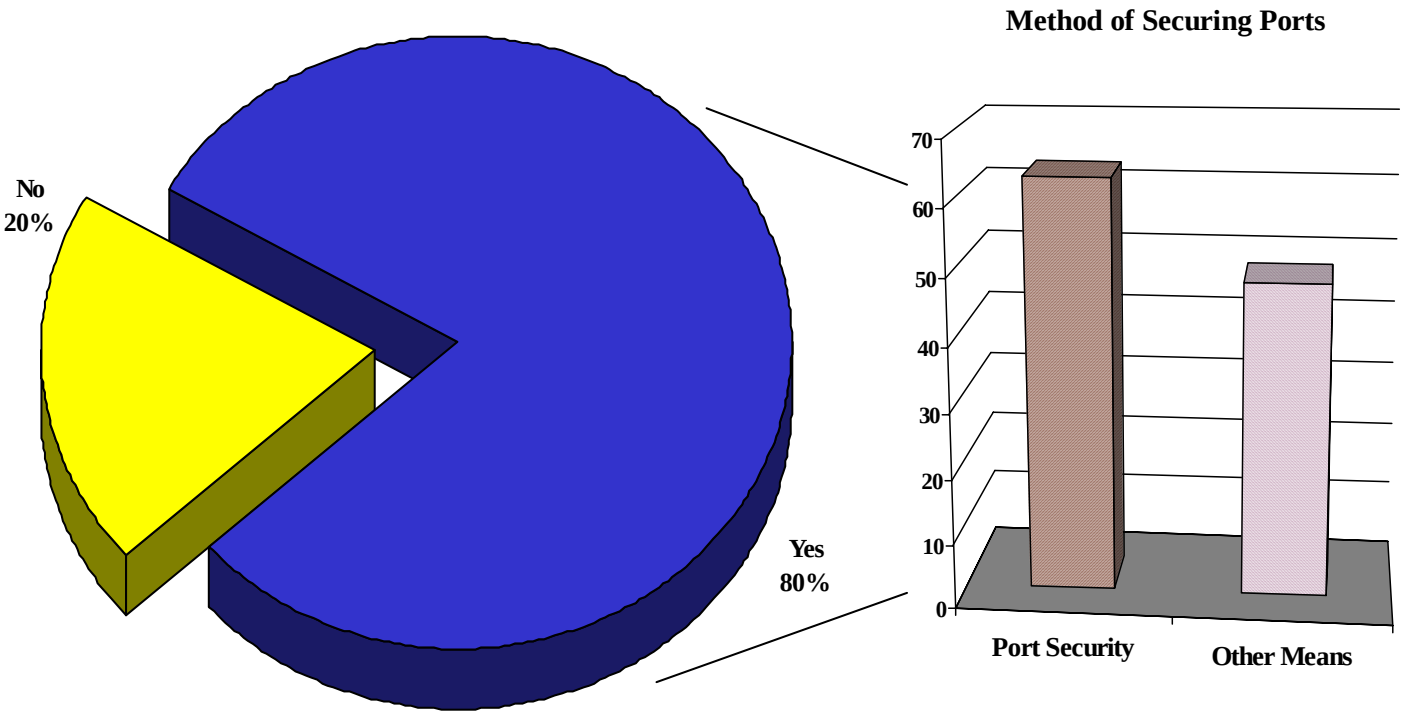
Security of Ethernet Ports



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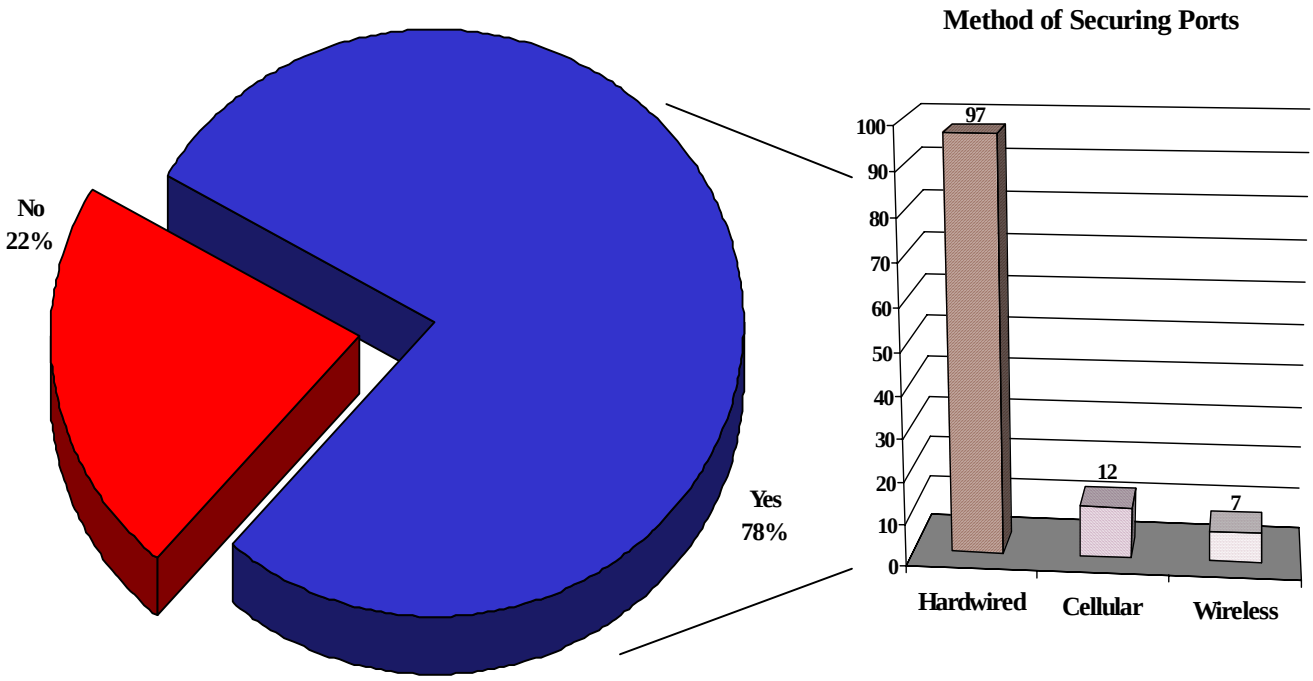
Use of Modems



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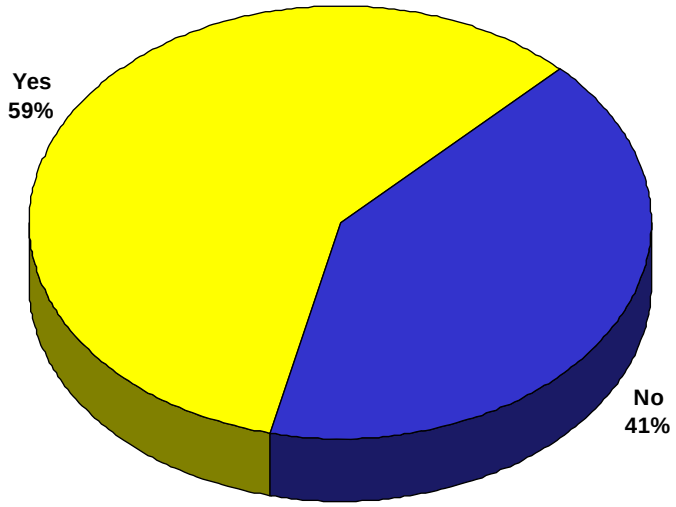
Remote Connections (such as Modems, IPS, Wireless Connections) Secured



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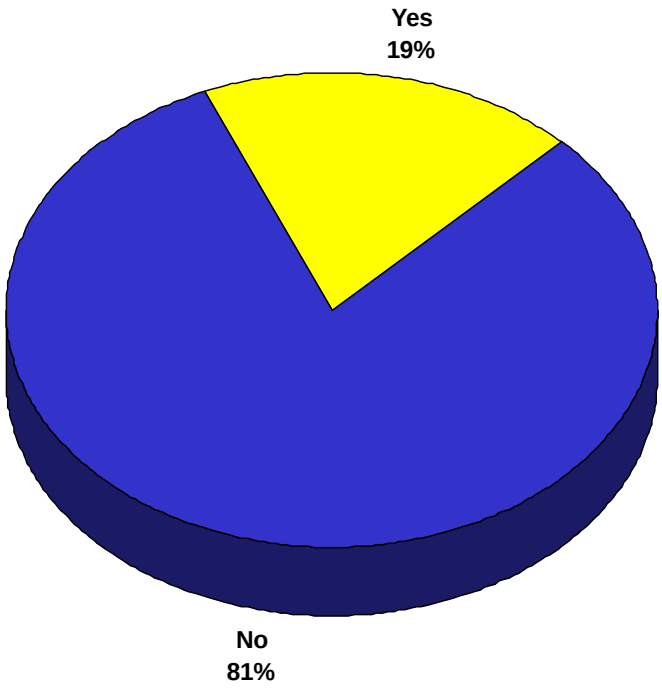
Communications in Remote Connections Protected (Encrypted)



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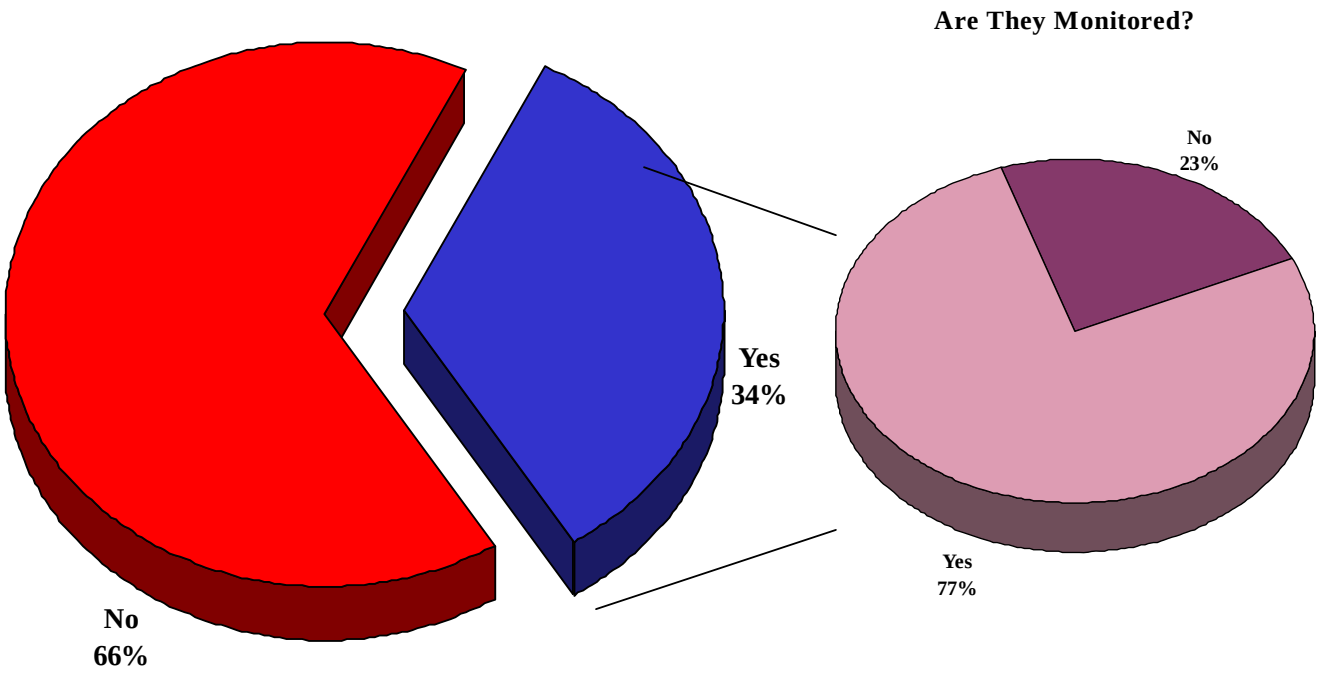
Use of Routable Paths to the End Devices



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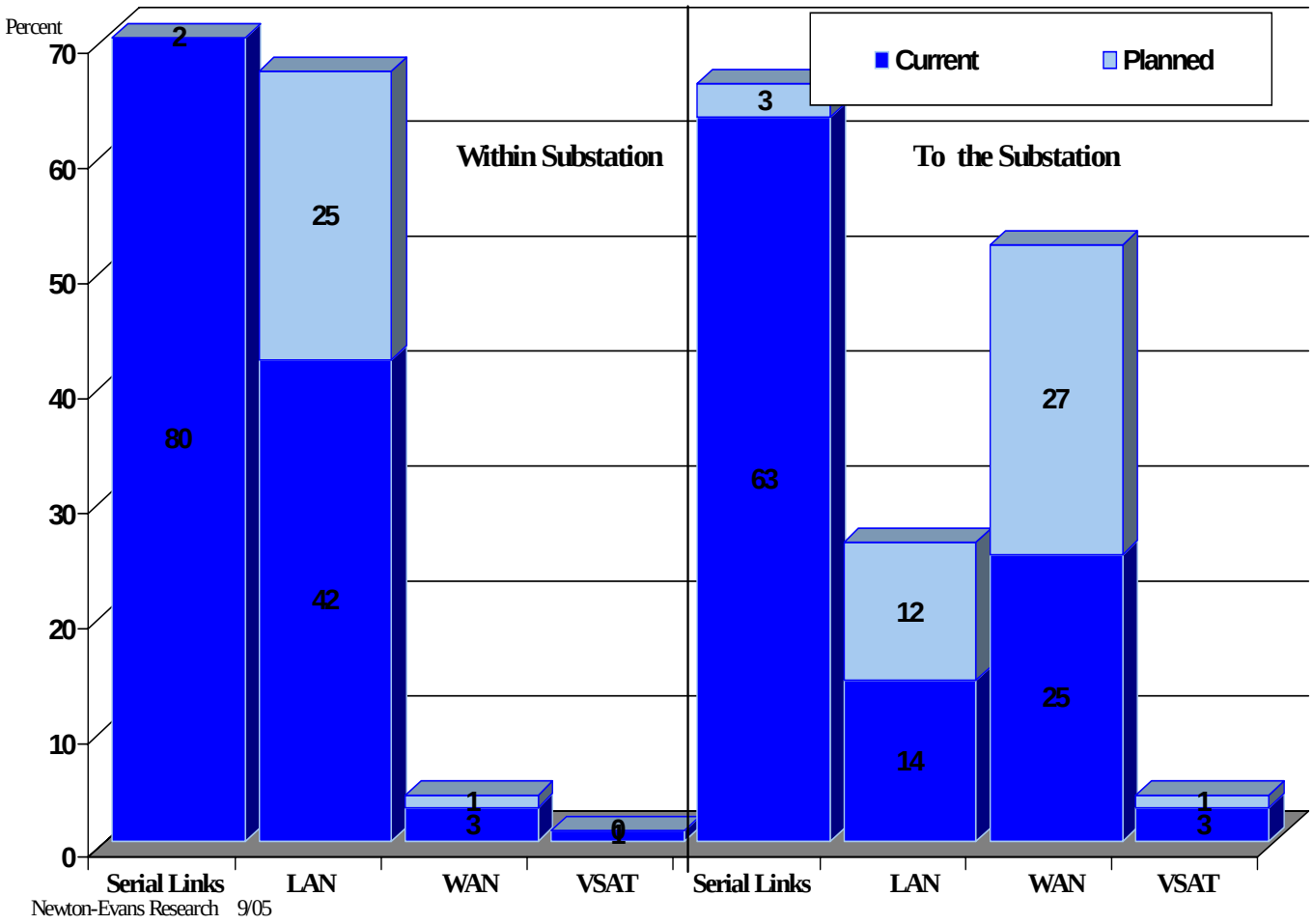
Choice of Communications Architecture
Within the Substation and *to* the Substation



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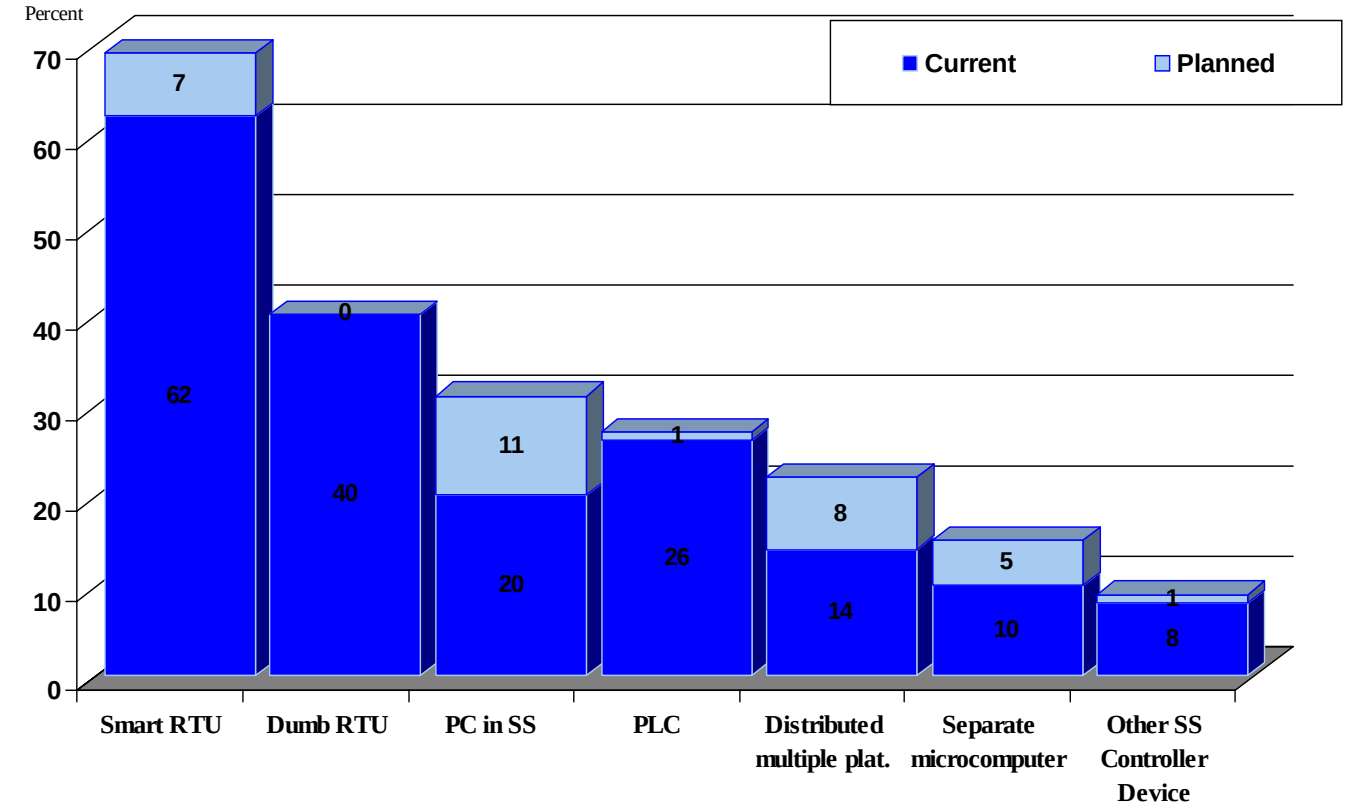
Methods for Handling "Inside the Fence"
Primary Substation Information Processing Tasks



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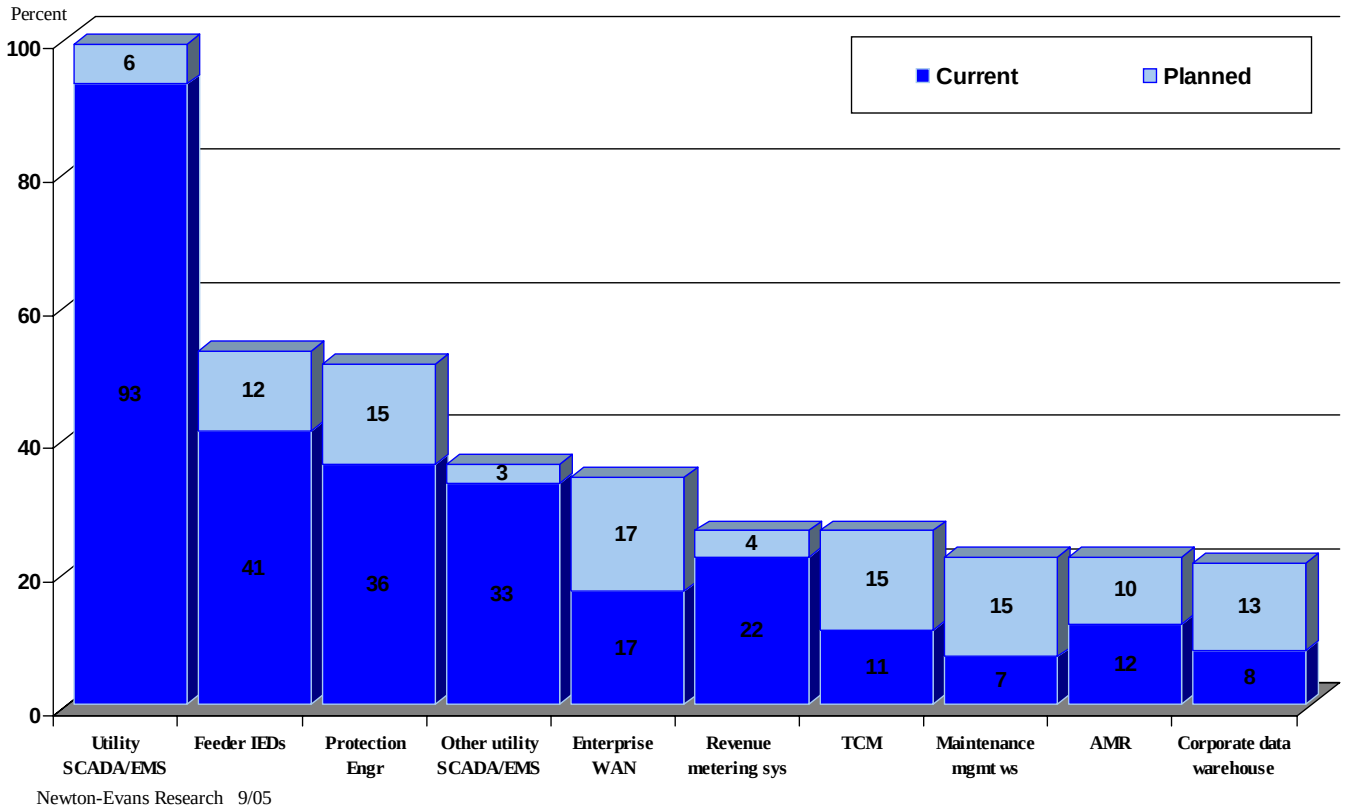
Utility Systems with which Automated Substation Systems/Equipment Currently/Plan to Communicate



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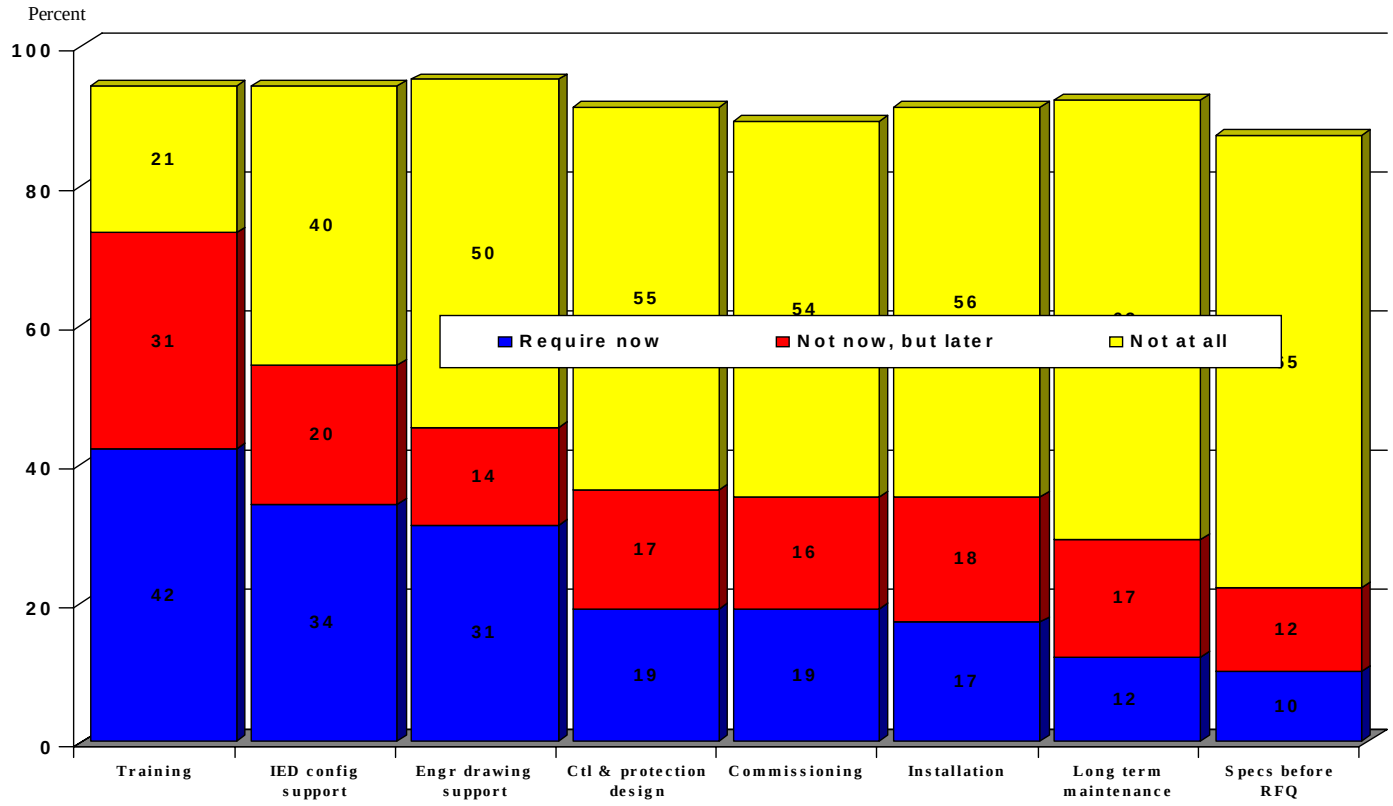
External Assistance Needed by Respondents for Substation Automation Related Activities



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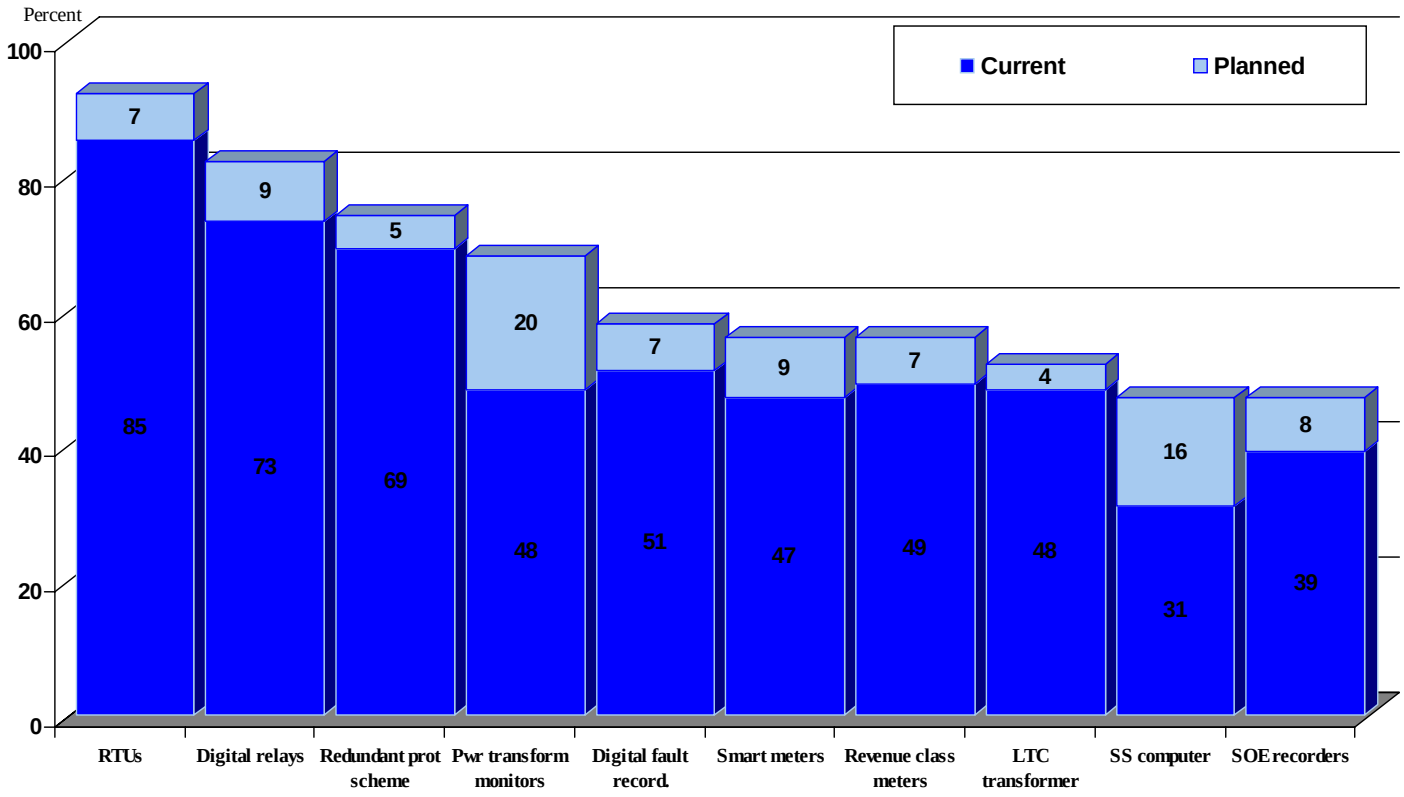
Specific Equipment Types Currently/Planned for as Part of *Transmission* Substation Automation Program



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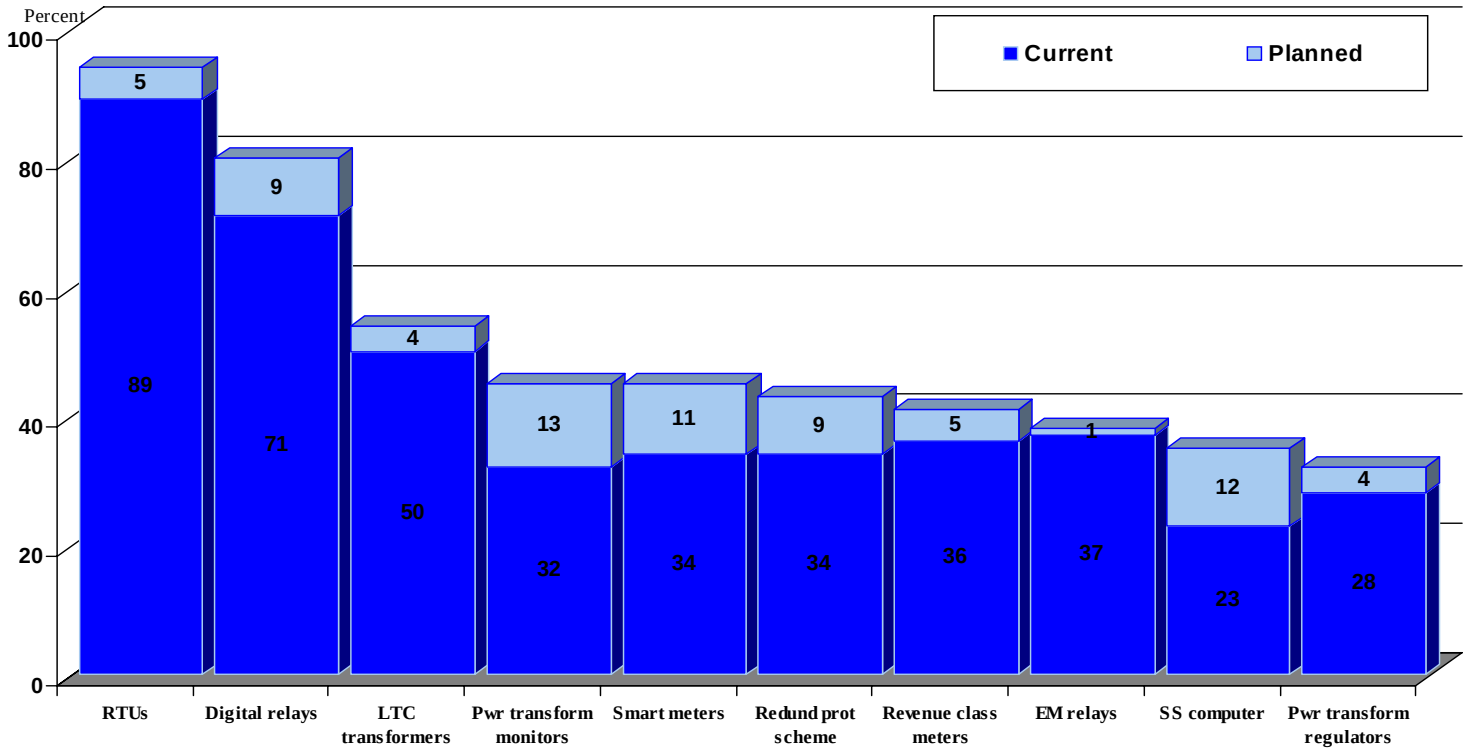
Specific Equipment Types Currently/Planned for as Part of *Distribution* Substation Automation Program



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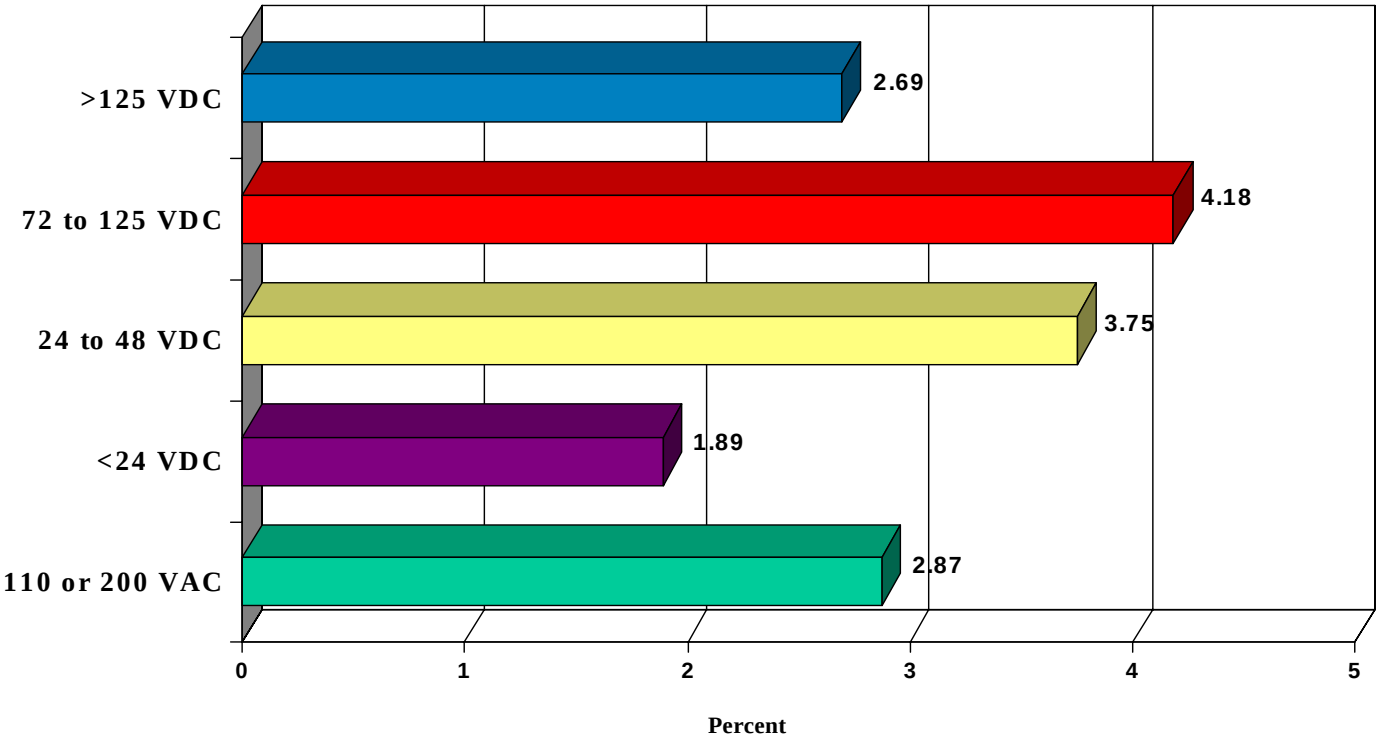
Voltage Ranges Used to Power the Substation Automation Equipment



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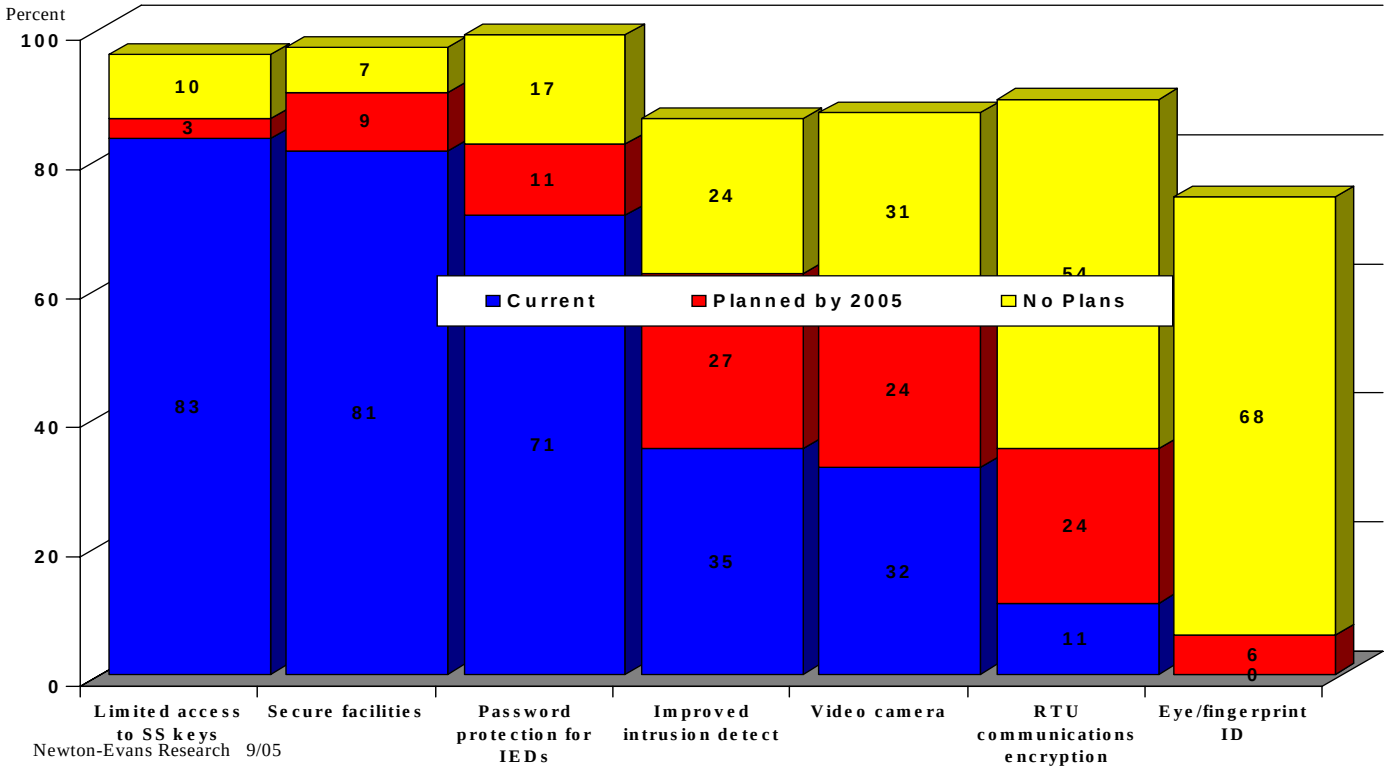
Current and Planned Usage of Substation Security Measures



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