India Smart Grid Forum

White Paper on

POST R-APDRP STRATEGY

About India Smart Grid Forum

India Smart Grid Forum (ISGF) is a public private initiative of the Ministry of Power (MoP), Government of India for accelerated development of smart grid technologies in the Indian power sector. ISGF was set up in 2010 to provide a mechanism through which academia, industry, utilities and other stakeholders could participate in the development of Indian smart grid systems and provide relevant inputs to the government's decision making.

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Abstract

In Nov 2013, Ministry of Power (MoP), Government of India, requested India Smart Grid Forum (ISGF) to study and prepare a white paper on the Post-Restructured Accelerated Power Development and Reforms Programme (R-APDRP) Strategy, as a brain storming exercise. While the R-APDRP is still an ongoing program, at some point a post R-APDRP scenario will have to be evolved. This white paper makes an attempt to begin the conversation and explores the possible extensions to the functionality of the distribution system operation in the Post R-APDRP scenario. Section-1 introduces the topic and provides a definition for Post R-APDRP scenario. Section-2 then provides a list of new projects that can be taken up in the Post R-APDRP scenario. Section-3 then presents a draft framework for integrating various other ongoing programmes (RGGVVY, JNNSM, NOFN, National Mission on Electric Mobility, National Knowledge Mission etc) in a phased approach in the post R-APDRP regime for transformation to smart grids. Section-4 provides key conclusions.

Acronyms

R-APDRP - Restructured Accelerated Power Development and Reforms Programme

RGGVY - Rajiv Gandhi GrameenVidyutikaranYojana

JNNSM - Jawaharlal Nehru National Solar Mission

NOFN - National Optical Fiber Network

GIS - Geographical Information Systems

AMR - Automated meter reading

AMI - Advanced metering infrastructure

MDM - Meter data management

MDAS - Meter data acquisition system

DR - Demand response

DSM - Demand side management

OMS - Outage management system

ERP - Enterprise resource planning

EV - Electric Vehicles

TOD - Time of the day tariff

TOU - Time of use tariff

KPI - Key performance indicator

1. Introduction on Post R-APDRP Strategy

1.1 R-APDRP Objectives & Challenges

R-APDRP Objectives

- Establishment of base line data and fixation of accountability.
- Reduction of AT&C losses through strengthening & up-gradation of Sub-Transmission and Distribution network and adoption of Information Technology

R-APDRP Coverage

It covered 1402 urban areas – towns and cities with population of more than 30,000 (10,000 in case of special category states). Projects under the scheme were mainly taken up in Two Parts [1]

Part-A: focused on establishment of baseline data and IT applications for energy accounting/auditing, consumer services and SCADA-DMS in larger towns

Part-B: focused on electrical network improvement, strengthening and augmentation etc.

The challenges faced during the implementation of GIS/AMR/MDM/MDAS under R-APDRP were primarily due to capacity constraints of utilities and implementation agencies, and the unrealistic time frames set for completion of the projects. The capacity issues were mainly due to simultaneous large scale deployments by many utilities which seriously depleted the very limited resources of the supply chain in the country. A study on the R-APDRP program has earlier been carried out and the findings are available on the India smart grid knowledge portal at the links [2] and [3]. There have also been some successful implementations in certain states, which have overcome the above challenges. Recently the R-APDRP team including experts from Power Finance Corporation (PFC) has also circulated a vision document titled “Beyond R-APDRP” [4] and invited comments from all stakeholders. This document by ISGF has been prepared in a similar visionary spirit and we believe that there are some good suggestions which can be taken up by the R-APDRP implementing nodal agency to further improve the program.

1.2 Post R-APDRP Definition and Objectives

Post R-APDRP can be defined as - "the scenario in which the IT & Automation Systems envisaged under Part-A have been successfully implemented and baseline data framework is established; and AT&C losses are measured accurately."

Building on the foundations of the R-APDRP programme, it is critical to ensure that the investments in the systems are leveraged, maintained and operated in a sustainable way by the Utilities. This will be the ideal point for transformation to smart grids.

1.3 Post R-APDRP – Key Performance Indicators (KPI)

Having clearly defined KPIs is essential in monitoring the progress in the post R-APDRP regime. To address this need, the R-APDRP team from PFC has also released a document titled "Post Go-Live Requirements" for state utilities, which spells out in detail measurable criteria to determine the status of working of the systems in the post go-live scenario [5].

2. Next Set of Projects in Post R-APDRP Regime

This section covers, the functionality that can be supported in addition to the existing functionality of R-APDRP. The actual methodology or the technologies needed to achieve these have to be evolved. Section 3 broadly describes a phased approach for achieving this new functionality.

1. Training & Capacity Building for Discom personnel for maintaining the R-APDRP Assets: Training of internal resources as well as sustainable models for efficient outsourcing of some processes has to be evolved.
2. Changes in Business Processes
    - The constantly changing physical electrical networks need to be captured in the digital network (model) simultaneously. This would require changes in basic business processes.
3. Load forecasting in Electricity Distribution
    - Data available from R-APDRP systems can be used for load forecasting including in the form of Short term / Medium term and Long term forecasting of loads in the distribution utility at the Category level (e.g. Industrial, Commercial, Residential etc.) and at various time intervals.
4. Continuous Distribution Strengthening Projects
    - Continuous Distribution Strengthening projects such as High Voltage Distribution Systems should be pursued on a continuous basis with the objectives of achieving high power quality, optimal voltage and reactive power profile and reduction of technical losses.
5. Introduction of Fault current limiters (FCLs) and fault current controllers (FCCs)
6. Usage of harmonics filters to mitigate harmonics
7. Additional Customer Services Offerings such
    - Bills on mobile/email

- Outage information through SMS
- Energy saving tips through SMS/portal
- “Green Button” information
- Multiple payment options
- Bill collection centres and Customer Service Centers
- TOD and TOU tariff

8. Extension of certain R-APDRP Part-A functionalities all across the Discom in a phased manner:

- Billing and CRM system
- Mapping of distributionassets in GIS – including RGGVY assets
- Indexing of consumers in GIS
- AMR for all Feeders and DT’s
- AMI for bulk consumers (each Discom may define bulk/high value customers)

9. Discom specific Smart Grid Roadmaps

10. State specific policies and regulations

11. ERP Systems in all Discoms

- Business Process Automation developed under RAPDRP has sufficient provisions in its software and hardware functionalities to integrate ERP

12. Extension of R-APDRP to smaller towns in a phased manner:

- All district HQs
- All towns with a population above 5000

13. Introduce Transformer Monitoring Systems in a phased manner:

- All 33/11 (66/11) transformers to be monitored in real-time
- All DTs in larger towns (1402 towns in the first set of R-APDRP) to be monitored in real-time
- All DT is District HQs to be monitored in real-time
- All DTs in towns above 5000 population to be monitored
- All DTs across the Discomto be monitored

14. NOFN integration – building dedicated backbone of communication network for the power sector by leveraging the NOFN:

- Interconnection of all 33kV and above substations with NOFN

- Fiber connectivity to all DTs in larger towns (1402 towns in the first set of R-APDRP)
- Fiber connectivity to all DTs in all district HQs

15. AMI Rollout in phased manner for all consumers.

16. Implement Distribution Management System (DMS) covering distribution network upto 11kV level.

17. Setup Power System control center for real-time monitoring/operations of distribution network upto 11 kV level.

18. Outage Management Systems (OMS) in all Discoms

19. Integration of OMS with GIS

20. Mobile Workforce Management Systems

21. Enterprise Application Integration & Analytics for the following

- Assessment of Residual Life of distribution assets such as underground cables, transformers, RMU's etc.
- Predictive maintenance using data from protective relays/ online asset monitoring systems. Analysis of AMI data would help in reduction of theft/losses, network planning etc.

22. Integration of network planning tool with the SCADA-DMS and GIS

23. Integration of network operations management with GIS

24. Leverage Smart Metering and AMI for

- Demand response (Auto as well Manual)
- Demand side management (DSM)
- Flattening of Discom level load curve through load curtailment
- Home automation systems
- Smart or Smart Ready Meters shall be provided for all new connections. Issues requiring attention will be Interoperability, suitability of various communication technologies like RF, PLC, WiMax etc. for large scale deployment of AMI and availability of dedicated spectrum for utilities. MDMS in addition to MDAS should be inherent part of AMI deployment.

25. Ester filled transformers

- Introduction of Natural /Synthetic ester filled Transformers in the Distribution/Sub-Transmission systems, as esters have excellent fire resistance properties and are environment friendly as compared to mineral oil.

26. Integration of DER's

- Integration of DER's with Grid will encourage green power. As many consumers are expected to become prosumers in future, integrated operation of Distribution systems with DER's would become an area of priority.
- The forecasting of renewable resources such as Wind, Solar has to evolve as a business process. The necessary forecasting tools need to be developed first and then should evolve into a business process.

27. Net metering

- Net metering, generation based incentives, safety guidelines would need to be in place. It would also be needed to develop suppliers and service providers for installation of DERs.

28. Integration of electric vehicles (EVs)

- EV's would help to reduce oil imports, enable DER through Vehicle to Grid (V2G), flattens Load curve and also encourage green power. Policies related to subsidies need to be in place. It would be needed to create EV Infrastructure such as charging stations, Battery swapping stations etc.

29. Microgrid Pilot Projects:

- Microgrid pilot projects for villages, academic campuses, hospitals etc. and demonstration in both "Stand-alone" (Off-grid) and "On grid" modes.

3. Phased Approach Post R-APDRP

The projects discussed in the previous section, should be taken up in a phased manner. There is also a need to dovetail the above Projects with following Programmes

1. RGGVVY – newly electrified villages can be connected to R-APDRP data centres and offering R-APDRP solutions (even if no GIS of consumer indexing in the first phase); offering bandwidth through BPL (if fiber goes up to DTs, Ethernet connection to LV side can send BPL signals for both telecom and internet in distance towns).
2. Electric Vehicle charging Infrastructure in all new public infrastructures of certain specified sizes and above
3. Rooftop PV for all public infrastructure of certain specified sizes and above
4. Rural households get connectivity to national knowledge network and digital libraries across the world

Accordingly, the following phased approach is proposed.

Phase 1 ***2014 - 2016***	***Phase 2*** ***2017 - 2019***	***Phase 3*** ***2020 - 2022***
• Shift of focus from products to processes • Define and track KPIs periodically at MoP level • Ensure utilization, maintenance, updates, upgrades and smooth operation of the installed systems • Extract lessons from smart grid pilots • Merge the post R-APDRP scenario with NOFN	• Extend the functionality of R-APDRP systems to support Smart Grid use cases • Synchronize the developments under part-A and part-B of R-APDRP	• Expand the smart grid roll out at national level • Merge the post R-APDRP scenario with other initiatives such as ○ RGGVY ○ JNNSM ○ Smart Grid Roadmap and Vision for India ○ National Mission on Electric Mobility ○ National Knowledge Mission

4. Conclusions

This document is an attempt to explore the possible initiatives that can be taken up in the post R-APDRP scenario. Various projects to enhance the functionality of the systems in the utilities are listed. The importance of combining these initiatives with on-going national programmes is also highlighted. A phased approach is presented for advancing today's utility grids to smart utility grids of the future. Further inputs from all stakeholders are invited for improvement of the suggested Post R-APDRP strategy.

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