



Post R-APDRP Strategy

A White Paper by ISGF – Dec 2013





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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 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. It also draws out several tweaks to the ongoing program that can facilitate an improved future scenario. Given R-APDRP is a building block for Smart Grids, the synergy is worth enhancing even today. 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 presents a draft framework for integrating various other ongoing programmes (RGGVVY, JNNISM, 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 conclusions.

**ACRONYMS**

AMI	Advanced metering infrastructure
AMR	Automated meter reading
BPL	Broadband over powerLine
CRM	Customer relationship management
DR	Demand response
DSM	Demand side management
ERP	Enterprise resource planning
EV	Electric vehicles
GIS	Geographical Information Systems
JNNSM	Jawaharlal Nehru National Solar Mission
KPI	key performance indicator
MDAS	Meter data acquisition system
MDMS	Meter data management system
NOFN	National optical fiber network
OMS	Outage management system
R-APDRP	Restructured Accelerated Power Development and Reforms Programme
RGGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
SCADA	Supervisory control and data acquisition
TOD	Time of the day tariff
TOU	Time of use tariff



1. INTRODUCTION ON POST R-APDRP STRATEGY

1.1 R-APDRP OBJECTIVES AND CHALLENGES:

R-APDRP OBJECTIVES:

- Establishment of base line data and fixation of accountability.
- Reduction of AT&C losses to below 15% through strengthening & up-gradation of Sub-Transmission and Distribution network and adoption of Information Technology

R-APDRP COVERAGE:

R-APDRP programme 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 funding for the Programme was primarily as a loan convertible to a grant on achievement of targets, and the Nodal Agency for the Programme is Power Finance Corporation (PFC). 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 unrealistically ambitious 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. There were also a few issues with the design in terms of choice of technologies and interpretation of the same. A standardized template (System Requirements Specification, or SRS) was given as a baseline, but this was overwhelmingly followed as-is, even when there were reasons to choose (improved) alternatives. 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 perspective and we believe that there are several good suggestions which can be taken up by MoP and PFC to further improve the program and take this journey towards building smart grids in India.



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. It is worth emphasizing that while R-APDRP was primarily a technical Programme, Smart Grids are a broader transformation spanning business operations, regulations, etc., all building upon suitable technologies.

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]. For a larger timescale, MoP has released a Smart Grid Roadmap for India [6], which can guide the short-medium term Post R-APDRP scenarios.



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** – This is 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. Regardless of whether ongoing system updates are made by internal staff or outsourced, very clear responsibilities are critical to ensuring accuracy of information down the road. A detailed document on the various types of training for different levels of employees is under preparation by ISGF based on the request of MoP. This document will be released by end January 2014; thereafter ISGF in coordination with other agencies will prepare the contents for various training modules that are not yet been prepared by PFC appointed training agencies.
- 2. Changes in Business Processes** – the constantly changing physical electrical networks need to be captured in the digital network (GIS map and power system simulation model) simultaneously. This is just one example of changes in basic business processes.
- 3. Customer Outreach and Education** – The end consumer need to be communicated about the benefits through advancements made in R-APDRP
- 4. 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 for each consumer category (e.g. Industrial, Commercial, Residential etc.) and at various time intervals and seasons
- 5. Strengthening of Distribution Networks:**
 - Distribution network strengthening projects such as High Voltage Distribution Systems may be pursued with the objectives of achieving high power quality, optimal voltage and reactive power profile and reduction of technical losses.
- 6. Introduction of Fault Current Limiters (FCLs) and Fault Current Controllers (FCCs)**
- 7. Use of harmonics filters to mitigate harmonics**
- 8. Provide Additional Customer Services Offerings**, such as:
 - Bills on mobile/email
 - Outage information through SMS
 - Energy saving tips through SMS / web portal / In home display
 - Provide consumption information to the end consumer similar to Green Button



- Multiple payment options
- Set up Bill Collection Centers and Customer Service Centers in wider areas
- Introduce TOD and TOU tariff for all consumer categories in a phased manner

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

- Billing and CRM system
- Mapping of distribution assets 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)
- The enabling equipment for part-A like RMUs should be in place well in time

10. Discom specific Smart Grid Roadmaps

11. State specific policies and regulations

12. ERP Systems in all Discoms

- Business Process Automation developed under RAPDRP has sufficient provisions in its software and hardware functionalities to integrate with ERP systems e.g. inventory and cost data from finance / purchase modules can be used in Maintenance management system to work out automatically the cost of work.

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

- All district HQs
- All towns with a population above 5000
- Towns which have been missed due to the criteria being census of 2001 (like Gurgaon) should be included.

14. Introduce Transformer Monitoring Systems in a phased manner:

- All 33kV/11kV (66kV/11kV) transformers to be monitored in real-time / SCADA for all distribution substations
- 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 periodically
- All DTs across the Discom to be monitored periodically

15. NOFN integration – building dedicated backbone of communication network to cover all 33kV / 66 kV substations for all Discoms. National Optical Fiber Network (NOFN) to be leveraged to reduce the cost.



16. AMI Rollout in phased manner for all consumer segments.

17. Implement Distribution Management System (DMS) covering distribution network up to 11kV level

18. Setup power system control center for real-time monitoring/operations of distribution network up to 11 kV level

19. Install Outage Management Systems (OMS) in all Discoms

20. Integration of OMS with GIS and ERP/Asset Management Systems

21. Integration of OMS with CRM and SCADA

22. Introduce Mobile Workforce Management Systems

23. Integrate Enterprise Applications with Business 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.
- Usage of AMI data to identify theft/losses, asset optimization and network planning etc.

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

25. Integration of network operations management with GIS

26. Leverage Smart Metering and AMI for

- Demand response for all consumer segments (Auto as well Manual)
- Demand side management (DSM)
- 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 in Indian context. Availability of dedicated spectrum for utilities and installation of dedicated MDMS in addition to MDAS should be inherent part of AMI deployment. The function of MDAS is to acquire meter data and would forward the same to MDM. MDAS would have feature to monitor communication network and performance of field devices. There could be multiple MDAS installed for acquiring meter data through different communication technologies like RF, PLC, GPRS etc. While there could be multiple MDAS systems in a utility there would only be one MDM system integrated with all MDAS. MDMS system would be the repository of all meter data (interval data, bill register data, and event data) and have validation, estimation, and editing features.



MDM would provide MIS reports on events, consumption trends, load factors and would be integrated with the billing system for automatic flow of readings from meter to billing system.

27. Introduce 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.

28. Integration of Distributed Energy Resources (DERs)

- Appropriate systems to integrate DERs with the Grid to encourage green power. As many consumers are expected to become *PROSUMERS* (producers and consumers) in the near future, integrated operation of Distribution systems with DERs 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.

29. Introduce Net metering for Rooftop Solar/Micro wind turbines/EVs

- Net metering (including its variants such as generation based incentives) along with required policies and safety guidelines would need to be in place for integration of rooftop solar and Micro wind turbines with the grid. It would also be needed to develop suppliers and service providers for installation of DERs.

30. Integration of electric vehicles (EVs)

- EVs would help to reduce oil imports, enable DER through Vehicle to Grid (V2G), flatten Load curves and also encourage green power.
- Policies related to creation of appropriate EV Infrastructure such as charging stations, Battery swapping stations etc to be taken up on priority.

31. Microgrid Pilot Projects:

- Set up Microgrid pilot projects for villages, industrial parks, large academic campuses, hospitals etc. and evaluate it's performance in both "Stand-alone" (Off-grid) and "On grid" modes.



3. PHASED APPROACH POST R-APDRP

3.1 COORDINATION BETWEEN POST R-APDRP PROJECTS & NATIONAL PROGRAMMES

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

- RGGVY – newly electrified villages can be connected to R-APDRP data centers and offering R-APDRP solutions (even if no GIS or consumer indexing in the first phase); offering bandwidth through Broadband over PowerLine (BPL) or other technologies (if fiber goes up to DTs, Ethernet connection to LV side can send BPL signals for both telecom and internet in distant villages).
- Electric Vehicle charging Infrastructure in all new public infrastructures of certain specified sizes and above.
- Rooftop PV for all public infrastructure of certain specified sizes and above.
- Rural households get connectivity to the national knowledge network and digital libraries across the world.
- Offer the digital assets created in the Discoms to other infrastructure services providers as additional revenue generation source for Discoms – for example: GIS maps that capture all buildings and roads of a town can be utilized by water supply utility, gas supply utility, and telecom services providers; the Billing & CRM Systems of the Discoms can be leveraged to collect water and gas bills, house taxes etc. In addition, multi-utility (smart) metering can also be offered.
- GIS maps / Master Plan details being captured by town planning authority / city development authority / Metro Rapid Transit authority is to be shared with utility which helps utility to plan for providing electrical infrastructure like substations/cabling/wiring for the upcoming areas. Utilities may get request for electrification at the far end of planning stage that makes difficult for getting land for substation, line or cables. Such problems should be avoided by proper coordination among stakeholders.



3.2 PHASED APPROACH POST R-APDRP

The following phased approach is proposed (note – these are not meant to be linear, and some States/Utilities can modify the timelines as feasible).

PHASE 1 2014 – 2016	PHASE 2 2017 – 2019	PHASE 3 2020 – 2022
<ul style="list-style-type: none"> • Shift of focus from products to processes (and service) • Define and track KPIs periodically at MoP level • Ensure utilization, maintenance, updates, upgrades and smooth operation of the installed systems • Merge Post R-APDRP scenario with the Smart Grid Roadmap and Vision for India • Extract lessons from smart grid pilots • Merge the post R-APDRP scenario with NOFN & BPL (remote villages under RGGVY) 	<ul style="list-style-type: none"> • 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 • Pilots leveraging R-APDRP assets to other infrastructure services providers (water, gas, house tax etc) 	<ul style="list-style-type: none"> • Expand the smart grid roll out at national level • Merge the post R-APDRP scenario with other initiatives such as <ul style="list-style-type: none"> ○ RGGVY ○ JNNISM ○ National Mission on Electric Mobility ○ National Knowledge Mission • Offer the digital infrastructure of Discoms for other Smart City services as additional revenue generation options



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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