NASPI Planning Committee Presentation on Data Management
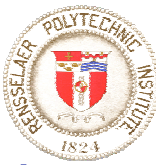
NASPI, Long Beach

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WECC Phasor Data

    i.   Sampling at 30 points/sec

    ii.   All sampled data start on integer second, with GPS signal arrival

    iii.   BPA PDC provide data in dst format. Several programs can read dst format – PNNL DSI program, SCE Power System Outlook program

   iv.   Data import into MATLAB straightforward, either directly from dst format or indirectly from csv format
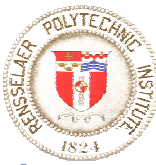
NASPI Planning Committee
Phasor Data Requirements for Off-line Application Analysis

EI: Oconee event (2/15/2007 16:49:00) data

| Companies	PMU locations * - transmitting data to TVA	Data retrieval	Record length	Data format	Points per sec
AEP*	Jackons Ferry, Kanawha River, Orange, Matt Funk, Rockport	AEP PDC	1 hour	csv	30
TVA*	Collinsville, Cumberland, Volunteer, Cordova	TVA PDC	20 min	Access database	15
NYISO	Edic, Athens (Mehta DSR)	modem	5 min, triggered event	csv	60
NYISO*	Niagara, Robinson Road, Marcy 765, Marcy 345 (2), Fraser, Blenheim-Gilboa	modem	3 min, triggered event	comtrade	6
NYISO*	Farragut (NYC)	TVA PDC	Not available then		?
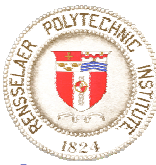
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Desired mode of Data Verification and Collection in EI

i. Synchronization – phasor data synchronized to exact seconds

ii. Sampling rate – possible rates: 6, 10, 12, 15, 30, and 60 points/sec. Suggested minimum rate of 30 points/sec for data conditioning.

iii. Data verification – examine phasor data from various locations to check calibration, timing, etc.

iv. Data collection, e.g., at and from TVA PDC – output phasor data with a common sampling rate to same file. Let researchers do re-sampling to align data. Preferred data file formats – dst, csv, comtrade

v. Data export – time, voltages, currents; frequency can be computed from bus angles

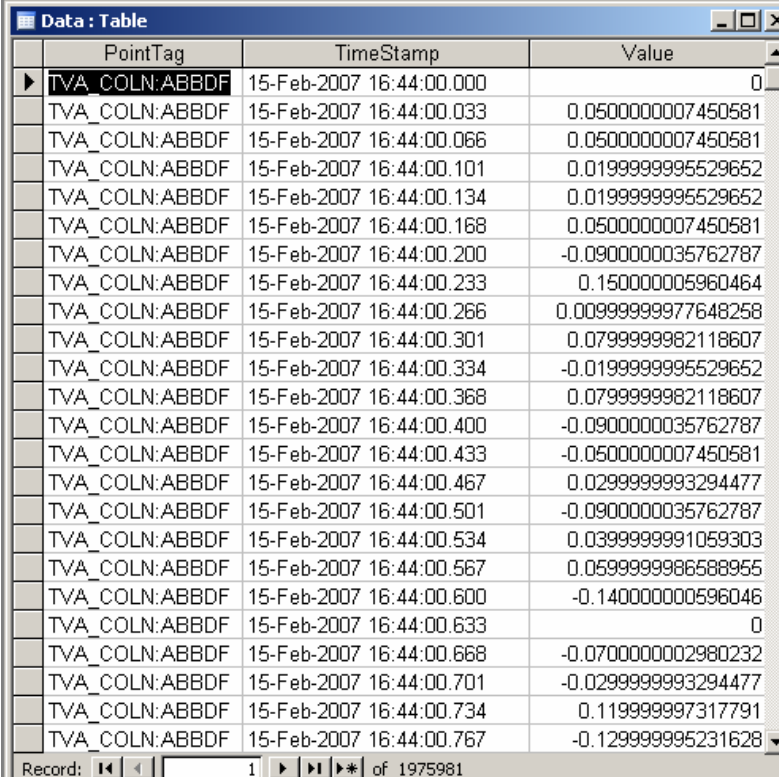vi. Long-term data storage – disturbance data should be stored forever at high-sampling rates
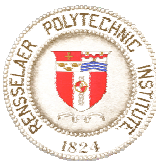
Data Collections and Issues

1. Oconee event (2/15/2007 16:49) data
   i. AEP data in good shape
   ii. TVA data
      a. Data in rows of three entries: variable label, time tag, and value
      b. ASCII output results in non-consecutive records
      c. Database can be read by MATLAB database toolbox, but difficult to automate
      d. Data loss: random, total loss of 5 seconds in 20 minutes; time consuming to locate data gap
   iii. NYISO
      a. Mehta DSR seemed to indicate a voltage oscillation, not seen in other data
      b. PMU data – some time tagging problems, comtrade conversion issues?

2. Sampling rate – what is the minimum?

Exporting TVA PDC Data (1)

- **Exporting issues:**
  - Export data for analysis in scientific environments (MATLAB, etc.)
  - Data exporting options are limited to ASCII .txt files and .csv files (readable by MATLAB and Excel)
  - Excel is limited to 65,536 rows by 256 columns.
    - TVA Data arranged in rows.
 - ASCII .txt files: will contain data swapping which is difficult to detect.

Data : Table

PointTag	TimeStamp	Value
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.000	0
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.033	0.0500000007450581
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.066	0.0500000007450581
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.101	0.0199999995529652
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.134	0.0199999995529652
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.168	0.0500000007450581
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.200	-0.0900000035762787
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.233	0.150000005960464
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.266	0.00999999977648258
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.301	0.0799999982118607
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.334	-0.0199999995529652
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.368	0.0799999982118607
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.400	-0.0900000035762787
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.433	-0.0500000007450581
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.467	0.0299999993294477
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.501	-0.0900000035762787
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.534	0.0399999991059303
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.567	0.0599999986588955
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.600	-0.140000000596046
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.633	0
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.668	-0.0700000002980232
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.701	-0.0299999993294477
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.734	0.119999997317791
TVA_COLN:ABBDF	15-Feb-2007 16:44:00.767	-0.129999995231628

Record: 1 of 1975981

Exporting TVA PDC Data (2)

- MATLAB Database Toolbox:
  - Connects the MS ACCESS OBDC database directly to MATLAB.
  - Uses SQL commands to build query to extract data into MATLAB.
 - Visual query builder can be used to form a query.
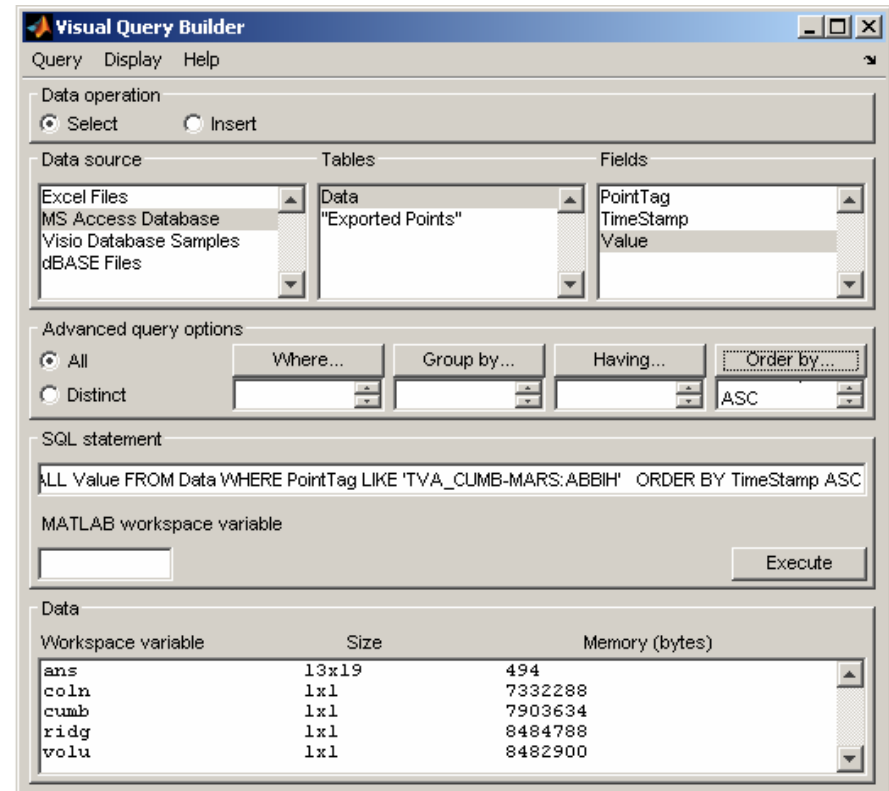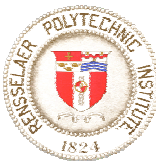
Exporting TVA PDC Data (3)

- **Processing issues:**
  - Data Extraction can be time consuming: 1 individual query per PMU Channel
    - Example: RIDG PMU has 15 channels + time tag → 16 queries must be built.
  - 4 TVA PMUs: 55 channels + 4 time tags → 59 queries.
  - Large amount of data: requires more computing capability (both RAM and CPU)

	RIDG PMU CHANNELS
1	TVA_RIDG:ABBDF
2	TVA_RIDG:ABBF
3	TVA_RIDG:ABBS
4	TVA_RIDG-BUS1:ABBV
5	TVA_RIDG-BUS1:ABBVH
6	TVA_RIDG-BUS2:ABBV
7	TVA_RIDG-BUS2:ABBVH
8	TVA_RIDG-HAWT:ABBI
9	TVA_RIDG-HAWT:ABBIH
10	TVA_RIDG-OGLE:ABBI
11	TVA_RIDG-OGLE:ABBIH
12	TVA_RIDG-PSR3:ABBV
13	TVA_RIDG-PSR3:ABBVH
14	TVA_RIDG-PSR5:ABBV
15	TVA_RIDG-PSR5:ABBVH
	+ TIME TAG

Exporting TVA PDC Data (4)
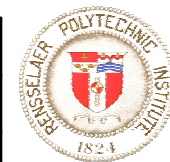
- Data Loss:
  - Data loss in the PMU Data of RIDG PMU.

- How to detect and treat lost data samples?

PMU DATA	EXPECTED TIME TAG
16:44:14.000	16:44:14.000
16:44:14.032	16:44:14.032
16:44:14.066	16:44:14.066
16:44:14.099	16:44:14.099
16:44:14.133	16:44:14.133
16:44:14.167	16:44:14.167
16:44:14.200	16:44:14.200
16:44:14.232	16:44:14.232
16:44:14.266	16:44:14.266
16:44:14.300	16:44:14.300
16:44:14.333	16:44:14.333
16:44:14.367	16:44:14.367
16:44:14.400	16:44:14.400
16:44:14.432	16:44:14.432
16:44:14.466	16:44:14.466
16:44:14.499	16:44:14.499
DATA GAP	16:44:14.533
	16:44:14.567
	16:44:14.600
	16:44:14.632
16:44:14.666	16:44:14.666
16:44:14.700	16:44:14.700
16:44:14.733	16:44:14.733