The Technical Design Report (TDR) for SAND in the ND complex

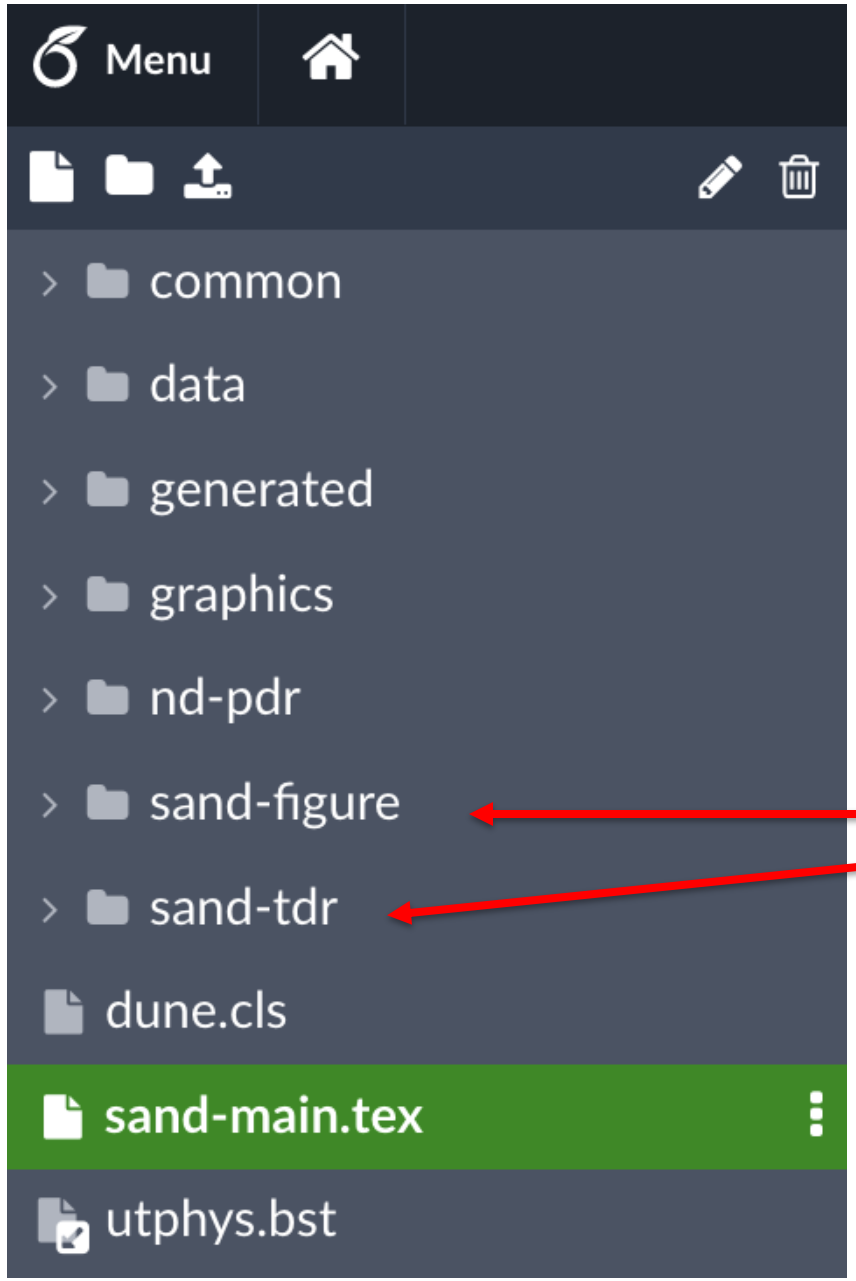
Paolo Bernardini, Lecce

DUNE, Italian Collaboration Meeting

October 30th, 2024

UNIVERSITÀ DEL SALENTO
L'Ateneo tra i due mari

INFN
Istituto Nazionale di Fisica Nucleare



An overleaf is adopted according to

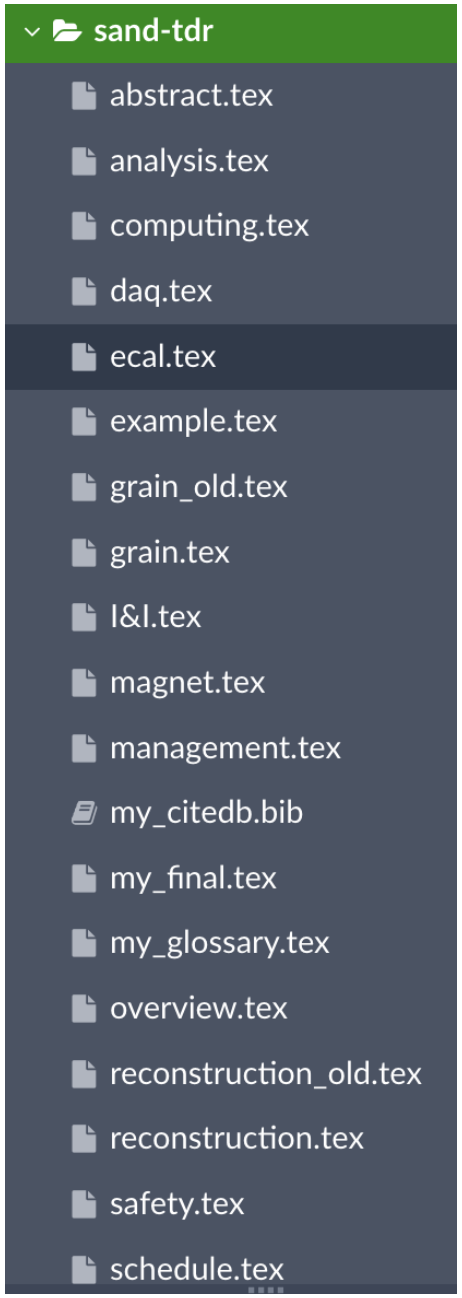
LATEX conventions for LBNF/DUNE documents

shared with SAND people
H.A. Tanaka (ND tech. coordinator)
A.E. Heavey (scientific editor)

The figures in sand-figure and the files in sand-tdr

are input for sand-main.tex

Dedicated overleaf for GRAIN
and SOFTWARE Working Groups,
periodically copied in main overleaf



Sections in the SAND chapter

1. Overview (requirements & opportunities)
2. Lead/Scintillating-Fiber Calorimeter (ECAL)
3. Superconducting Magnet
4. Liquid Argon Active Target (GRAIN)
5. Tracker
6. Data Acquisition (DAQ) Architecture
7. Detector Control (DCS)
8. Detector Safety System (DSS)
9. Software & Computing
10. Event Reconstruction
11. Analysis
12. Installation & Integration
13. Safety
14. Organization & Management
15. Time Schedule
16. Possible Upgrades

Calibration spread in several sections

my_glossary.tex
my_citedb.bib

New DUNE words and new references in evidence (at the file end)

7 pages

Updated according to the task-force document (approved in DUNE general meeting, May 2024)

To do: careful reading and corrections (LS e CM)

Possible improvements (mainly in Sec. 1.1.4)

66 pages

✓ Draft available in time

✓ July 22-23, 2024 - Preliminary Design Review (PDR)

To be updated according to PDR recommendations

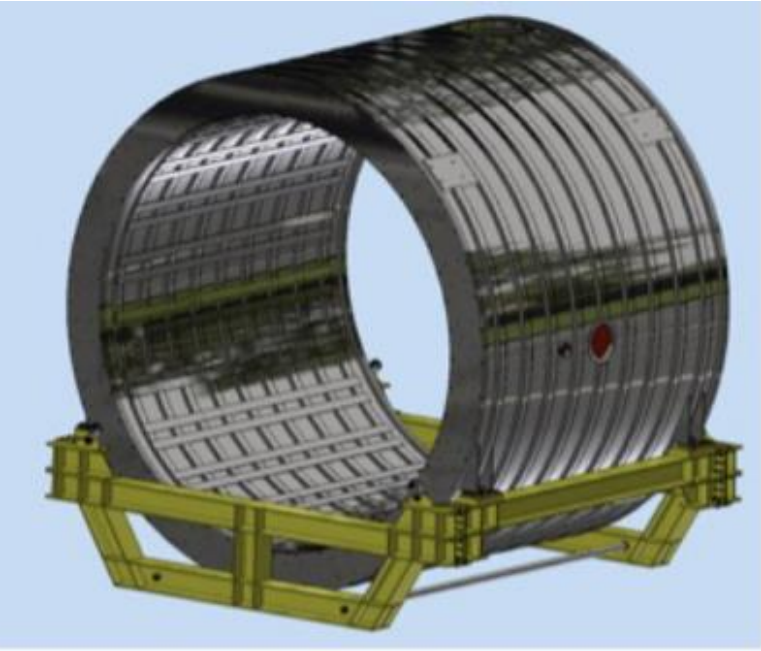
Expand hazard & risk analysis, shipping details, resources loaded schedule and cost analysis

Talk by Antonio D.D.

Gantt & milestones to be updated

Refinements expected within October 31

25 pages



✓ Draft available in time

✓ July 22-23, 2024 - Preliminary Design Review (PDR)

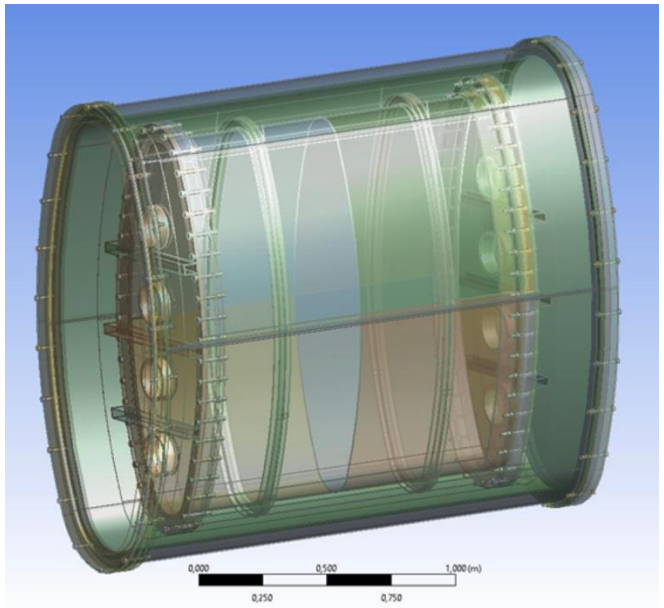
To be updated according to recommendations

Update of design, dismounting and shipping of the yoke

Possible improvements (mainly in Sec.s 1.3.4, 1.3.5, 1.3.6)

Refinements expected within October 31

28 pages



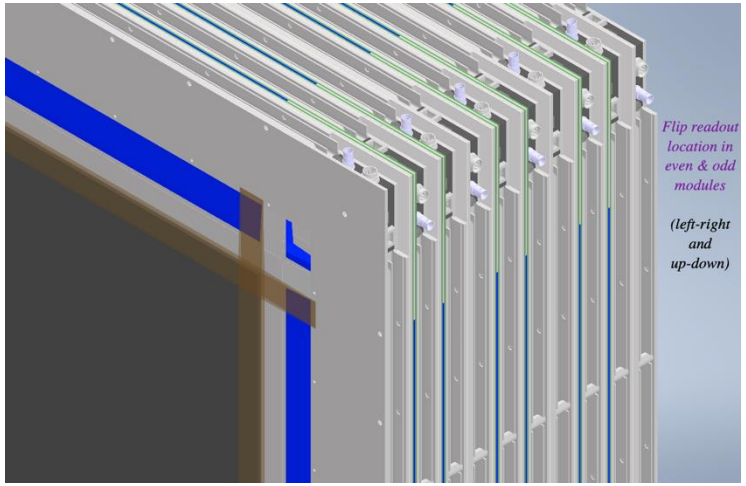
Present - physics requirements - mechanics - lens description
- SiPM arrays - ASIC requirements

To be completed - coded mask description - reconstruction with voxels* * another section ?
- 3D reconstruction* - performances

To be written - prototypes - DAQ & slow control - calorimetry
- calibration - cryogenics - integration & installation

Next check: November 15 Complete draft: November 30

6 pages

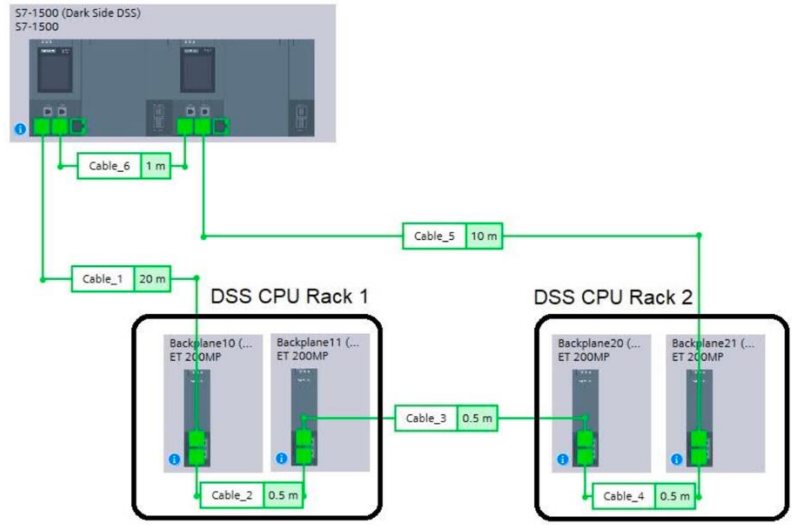


Present - figures and tables about STT geometry

Missing – 14 subsubsections about STT
- subsection about Drift Chamber
- subsection about Gas System

Next check: November 31 Complete draft: December 2024

8 pages



Ready draft - DSS

To be completed - DAQ (expected data rates, interfaces)
- DCS (preliminary layout, DAQ interfaces)

Next check: ??

Complete draft: ??

25 pages

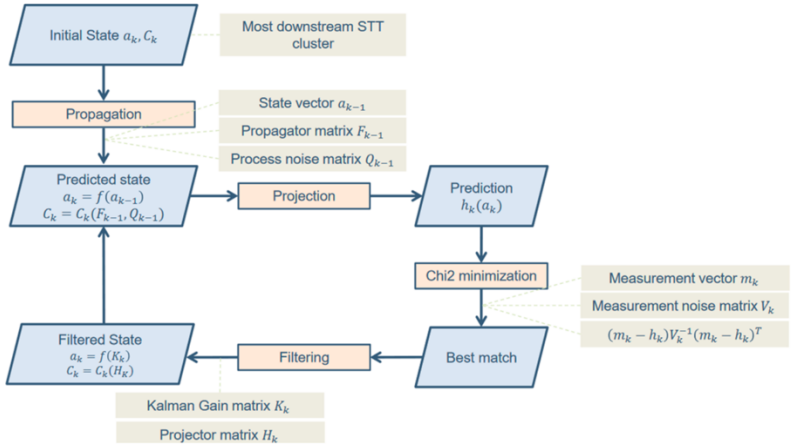


Figure 1.108: Flow chart of the EKF algorithm.

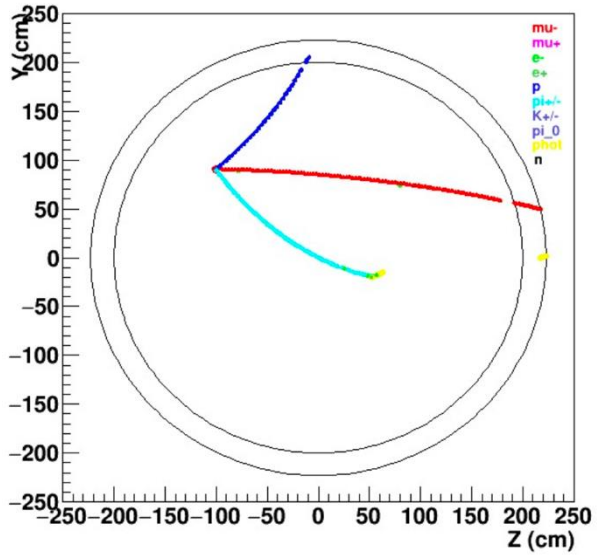
Present
- GRAIN simulation
- Kalman filter (with B)
- ECAL simulation & clustering
- edep-sim output

Missing
- simulation of ν fluxes, geometries
- reconstruction in GRAIN*, ECAL
- Common Analysis Files
- computing architecture
- event display
- integration

* another section ?

Complete draft: December 24

52 pages



Present - single particle reconstruction
e, π^0, γ, p, n, K^0, Λ^0
helix 3D fit in STT and ToF method
- particle ID (e, p, μ, π)
- neutrino energy reconstruction

To write - reconstruction in GRAIN*

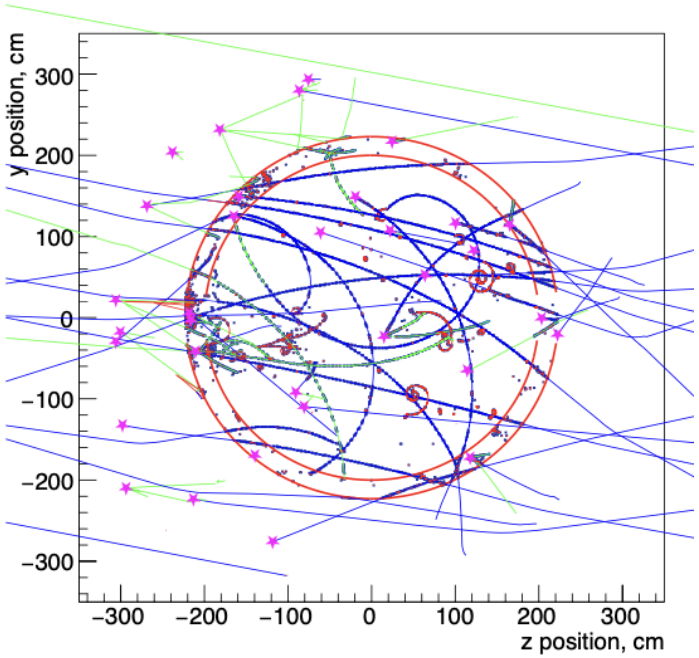
Future - identification of neutrino event in the spill

Mainly from the document DUNE-doc-13262-v7

"A Proposal to Enhance the DUNE Near-Detector Complex"

GEANT & FLUKA

80 pages



Present
- selection of CC interactions (ν_μ, anti ν_μ, ν_e, anti ν_e)
- ν-H interactions
- measurement of fluxes
- nuclear smearing in Ar
- ν-e scattering
- coherent π production
- on-axis beam monitoring
- ν_e/ν_μ ratio
- external backgrounds

To do
- careful reading and corrections (volunteers ?)
- possible new topics

From the document DUNE-doc-13262-v7

"A Proposal to Enhance the DUNE Near-Detector Complex"

To be written

Present: tables about sizes, weights and storage @ FNAL of yoke, coil and calorimeter

Expected: November 31

See talk by C. Montanari

Present: time schedule from the single sections

Next check: November 30 Complete draft: December 2024

Present:
316 pages

259 figures
65 tables

1. Overview — 7 pages – to be checked
2. Lead/Scintillating-Fiber Calorimeter (ECAL)
3. Superconducting Magnet

} **91 pages – to be updated**

4. Liquid Argon Active Target (GRAIN) — 28 pages – in progress
5. Tracker — 6 pages – at the beginning
6. Data Acquisition (DAQ) Architecture
7. Detector Control (DCS)
8. Detector Safety System (DSS)

} **8 pages – to be completed**

9. Software & Computing — 25 pages – at the beginning
10. Event Reconstruction — **52 pages – to be completed**
11. Analysis — **80 pages – to be checked**
12. Installation & Integration
13. Safety
14. Organization & Management
15. Time Schedule
16. Possible Upgrades

} **At the very beginning (some tables)**
1-2 pages for each section
Indexes and keywords are defined

Long todo-list

Essentialy missing or wrong references

Standardize (as possible) quantity names, reference systems and so on

Each author responsible his/her section introduces update when necessary

Check priorities

Physics and coherence
English language
Rules of the DUNE documents

but ...

Todo list

Instructions for the authors

- Insert the reference in the bibliography (bibitex format)
- Check if some word is present in the glossary and use it
- Insert new words in the glossary
- Check the reference to equations, figures, tables
- Write your name in the text %% author ?
- Take into account the DUNE editing rules

https://dune.bnl.gov/docs/guidance.pdf

Glossary

my_glossary.tex

Insert new DUNE words and new DUNE abbreviations at the end of this file

Check if the word is already present

To define a DUNE term that has no abbreviation use:

```
\newduneword{label}{term}{description}
```

To define a DUNE term with an abbreviation use:

```
\newduneabbrev{label}{abbrev}{term}{description}
```

Examples

```
\newduneword{detmodule}{detector module}{The entire DUNE far detector is
  segmented into four modules, each with a nominal \SI{10}{\kton}
  fiducial mass}

\newduneabbrev{adc}{ADC}{Analog Digital Converter}{A sampling of a voltage
  resulting in a discrete integer count corresponding in some way to
  the input}
```

Bibliography

my_citedb.bib

Insert references (bibtex format) at the end of this file

Check if the reference is already present

DUNE Words from the glossary

\dfirst{fnal}	first time	Fermi National Accelerator Laboratory (Fermilab)
\dword{fnal}	following times	Fermilab

More informations in the glossary

Fermi National Accelerator Laboratory (Fermilab) U.S. national laboratory in Batavia, IL. It is the laboratory that hosts Deep Underground Neutrino Experiment (DUNE) and serves as its near site. 1

\dfirst{nd}	near detector (ND)	*with link*
\dword{nd}	ND	*with link*
\dlong{nd}	near detector	*w/o link*
\dshort{nd}	ND	*w/o link*

\dword	singular	\dwords	lower case & plural
\Dword	capital	\Dwords	capital & plural

common/units.tex to define commands for units

Examples

"m" is written `\si{\meter}` **bare units**

"V" is written `\si{\volt}`.

"123.456" is written as `\num{123.456}`. **bare numbers**

"1±2i" is written as `\num{1+-2i}`.

"3×10^{45}" is written as `\num{3e45}`.

"0.3×10^{45}" is written as `\num{.3e45}`

"120 GeV" is written as `\SI{120}{\GeV}`, **numbers and units**

"4850 ft" is written as `\SI{4850}{\ft}`,

Figures

JPEG use for photographs

PDF use of any line drawings, plots, illustrations

PNG use due to some inability to produce proper JPEG or PDF (contact editors)

Please, complete the plots with axis labels and measurement units

English

- Use American spelling: e.g., ionization (not ionisation), flavor (not flavour) and so on.
- In general, avoid use of first person (e.g., I, we, our). "We" may appear in introductory sections.
- Avoid use of second person, i.e., "you."

SAND: Design Milestones

SYSTEM	DECISION	Date
SAND	*GRAIN inner cryostat material*	*2024*
SAND	Tracker technology	2025 Q3
SAND	ECAL readout	2025 Q1
SAND	GRAIN outer vessel material	2025 Q4
SAND	GRAIN readout configuration	2025 Q4

H. A. Tanaka
Neutrino Scope Group
23 October 2024

- SAND is on the path to preliminary design.
  - A few major decisions (Tracker, GRAIN readout configuration) remain pending prototyping results
- Some elements (Magnet, ECAL) are built and undergoing refurbishment
  - Close coordination is needed to ensure smooth compliance and testing process at FNAL.

RECENT AND UPCOMING REVIEWS

SYSTEM	Review	Date
SAND	*KLOE-2-SAND Preliminary Design Review*	*2024 Q2*
ND-LAr Cryostat	*Preliminary Design Review*	*2024 Q3*
TMS	Preliminary Design review	2025 Q1
PRISM	Preliminary Design review	2025 Q1
ND-LAr	Final Design Reviews start	2025 Q1
ND-LAr/TMS	ND Director's Review and IPR status review	2025 Q2
SAND	GRAIN readout configuration	2025 Q4

Hiro Tanaka, September 9, 2024
Collaboration Meeting

	Chapter Draft	Design Review	Ready for LBNC
Intro/Physics	Jun 24	N/A	Jul 24
ND-LAr (final)	Nov 24	Dec 24	Feb 25
TMS	Nov 24	Jan 25	Feb 25
SAND*	Jun 24-Feb 25	Jul 24-Mar 25	Apr 25
ND-LAr Cryostat	Jun 24	Jul 24	Aug 24
NS LAr Cryogenics	Jun 24	N/A	Aug 24
DUNE-PRISM	Nov 24	Dec 24	Jan 25
ND DAQ	Nov 24	Jan 25	Feb 25
ND Slow Control			Feb 25
ND I&I	Nov 24	Dec 24	Jan 25

* SAND will divide process into KLOE-2-SAND, Tracker, GRAIN, Integration

Final remarks

- Write-up of SAND-TDR has started (February 2024) and is going on
- Main part of data are available, it's just a matter of writing
- First review about ECAL+magnet in July 2024
- 2024 end as deadline for a first complete draft
- What measurement to evaluate the TDR progress ?

  Number of pages: 315 !
  Text quality ? Difficult answer

- To do:
  - Some sections to be written and completed
  - Editing according to DUNE rules
  - SAND internal reading to "measure" the text quality
  - When a first draft in DUNE-docdb ? Soon !!!

Backup slides

Many many rules/instructions in the writing of DUNE documents :

https://github.com/DUNE/document-guidance/releases/	Latex structure
https://ctan.mirror.garr.it/mirrors/ctan/macros/latex/contrib/siunitx/siunitx.pdf	units
https://dune.bnl.gov/docs/technical-proposal/dune-words.pdf	DUNE words
https://ctan.mirror.garr.it/mirrors/ctan/macros/latex/contrib/glossaries/glossaries-user.pdf	glossary

An almost synthetic guidance (49 pages) https://dune.bnl.gov/docs/guidance.pdf

Help by Anne Heavey, scientific editor at FNAL

Anne Heavey

Scientific editor

Fermilab, United States

Hiro Tanaka, September 9, 2024
Collaboration Meeting

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More details for SAND

Preliminary Design Review

	topics
✓ Jul 2024	ECAL + magnet
Nov 2024	I & I
Dec 2024/Jan 2025	GRAIN
Mar 2025	Tracker

Review of TDR chapter draft

	reviewer
Jan 2025	SAND consortium
Feb 2025	DUNE collaboration
Mar 2025	LBNC