Writing NREL documents using LaTeX

A. Clifton, M. Dennis, A. Platt, P. Fleming, M. Lawson

Thursday 28th January, 2016

Executive Summary

This document is a guide to writing documents for publication by NREL using the LaTeX document preparation system. LaTeX is not WYSIWYG and has different reviewing and editing tools compared to typical word processing software. For this reason special care has to be taken when preparing NREL documents in LaTeX.

This document serves both as a guide to implementing NREL's style and formatting guidelines in LaTeX, and as a template. This document is intended for people with some familiarity with LaTeX.

Acknowledgments

This document and the NREL LaTeX class file were developed by staff at the National Wind Technology Center, including Andrew Platt, Andrew Clifton, Andrew Ning, Mike Lawson, and Paul Fleming. Alexsandra Lemke provided support relating to NREL communications. A first demonstration of an NREL class file was created by Chuck Booten from NREL's Electricity, Resources, and Building Systems Integration group, which inspired this effort. The class file and this template were developed as part of work on several NREL reports, journal articles, and conference publications.

We thank members of the TeX – LaTeX StackExchange site for useful suggestions concerning LaTeX and typography (Anon. 2014).

This report was typeset using the LaTeX typesetting system originally developed by Leslie Lamport, based on TeX created by Donald Knuth.

Contents

List of Figures

List of Tables

1 What is LaTeX?

LaTeX is a mark-up language that describes how a document should be prepared.

Three things are needed to make a LaTeX document:

1. A source document, usually with extension *.tex*
2. Some packages and classes that help turn what's in the source document into something helpful
3. A compiler, also referred to as a working LaTeX installation.

At first glance the source document looks like a programming language, and that's because it is: LaTeX is not WYSIWYG, like many of the document preparation tools in common use today. A good analogy to LaTeX is html code, which can be read in any text editor but is rendered by web browsers into a finished product.

1.1 Printed Resources

Several excellent LaTeX references exist and may be found useful by some users. Examples include those by Knuth (1984) and Lamport (1986).

1.2 Online Resources

The wikibook at http://en.wikibooks.org/wiki/LaTeX is an excellent resource. There are also several internet forums such as tex.stackexchange.com that may be useful.

Documentation for the packages used in the nrel.cls file (Section 3.2) can be found at ctan.org.

2 Requirements for NREL documents

There are well-defined requirements for all documents that are published by NREL.

2.1 NREL style guide

The NREL in-house style is described at http://www.nrel.gov/extranet/communications/styleguide.html. This details the conventions that should be used when writing NREL documents.

2.2 Formatting

NREL publishes templates for reports and other technical documents. These are designed to be used with most common WYSIWYG programs and latex. Templates are posted online at http://www.nrel.gov/extranet/communications/report_template.html and updated regularly.

3 Using LaTeX to make documents that meet NREL's requirements

A LaTeX class called *nrel.cls* has been written that implements NREL's formatting requirements in LaTeX. Authors are required to use this class file to create NREL documents.

3.1 NREL's LaTeX Environment

3.1.1 Web Interface

NREL authors are strongly encouraged to use the NREL-hosted web-based latex environment to produce documents from LaTeX. This can be found at latex.nrel.gov and is based on the open source interface used by sharelatex.com. More information can be found at latex.nrel.gov.

Advantages of latex.nrel.gov include:

1. No need to maintain a local version of LaTeX
2. Everyone uses the same version of LaTeX
3. Editors and reviewers can work in a user-friendly environment
4. There is an always-on "track changes" feature
5. Secure hosting of documents within the NREL domain
6. Ability to download source documents for archiving

3.1.2 Starting new documents

1. Go to https://github.com/NREL/latex_editing and download the repository as a .zip file from the icon on the lower right hand side of the page.
2. Got to latex.nrel.gov and start a new project by uploading the zip file. Modify the project properties (name, collaborators, etc) as required.
3. Modify *main.tex* as required.

Authors are welcome to use their own installation of LaTeX to prepare a document using the *nrel.cls* file, but should note that they will need to transfer the document to latex.nrel.gov at some point.

3.1.3 Working with pubhub

pubhub.nrel.gov is NREL's web-based publications management software. Pubhub should be used in different ways depending on the stage that the document is at.

- Editing documents:
  - Authors check in the PDF and provide a link to the latex.nrel.gov document.
  - Authors add the latex.editor@nrel.gov user to their document
  - The editor logs in to the latex.editor@nrel.gov account on latex.nrel.gov to make edits. The author may need to support some modifications. Comments should be added on a new line after the % symbol, and will be found by the "track changes" feature.
- Reviewing documents:
  - Approvers can work on either the PDF or the LaTeX document, noting that working on the latex.nrel.gov document requires an internet connection.
- Final documents:

– All files used to prepare the latex document should be downloaded from latex.nrel.gov and stored in pubhub once the final document has been published.

3.1.4 FAQs for working with latex.nrel.gov

A separate FAQ that is updated regularly is available to NREL users at latex.nrel.gov.

3.2 The nrel.cls class file

nrel.cls provides the *nrel* document style and controls the formatting and presentation of documents so that they meet NREL's requirements.

The *nrel* document class is a meta-class, in that documents must also be identified as being one of the basic LaTeX document classes in the options that are passed to the class. Options are passed to the class in the `\documentclass` line:

\documentclass[option1,...,optionn]{nrel}

This line specifies the options (inside the square brackets) that will be passed to the *nrel* class. The options include:

book compile the document using the LaTeX *book* class. This is intended for longer documents and allows the use of chapters.

report compile the document using the LaTeX *report* class. This is intended for longer documents and allows the use of chapters.

article compile the document using the LaTeX *article* class. This is intended for shorter documents such as journal articles. This class does not support the use of chapters. The Github repository includes an example of the article option being passed to the NREL class in *mainArticle.tex*.

memoir compile the document using the LaTeX *memoir* class. This option is not recommended because of the challenge with later converting to RTF format for communications review.

draft add a 'draft' watermark to all pages and colours all links in blue.

10pt, 12pt set the font size accordingly. The default is 12 point.

letterpaper, a4paper set the paper size. the default is letter paper.

nrel.cls calls a variety of other packages. Packages are codes that modify the appearance or behaviour of LaTeX to achieve something. Table 1 lists the packages that are explicitly called by *nrel.cls* in the order they are called in. These packages often call other packages, so this is not an exhaustive list.

It should be noted that the 'english' option to Babel really means *American English*.

3.3 Creating Content

3.3.1 Front, main, and back matter

NREL's convention is to have Roman numerals in the front matter, and then arabic numerals in the main matter of the document (after the tables of contents, figures and tables). Tables and figures in the front matter are also numbered differently (Table A, B, C, ...) than in the main matter (Table 1, 2, 3, ...).

This change in page and float numbering is implemented using the `\frontmatter`, `\mainmatter`, and `\backmatter` commands at the start of these sections of the document:

\begin{document}

\maketitle
\frontmatter

Table 1. Packages loaded by nrel.cls.

Package	Options	Functionality
amsfonts, amssymb		supplies AMS fonts, which are useful for mathematics
babel	english	activates language-appropriate hyphenation rules
booktabs		improves the formatting of tables
caption		required to generate captions for floats
courier		changes fonts
fontenc	T1	enables direct typing of international characters
geometry		sets page size and margins
graphicx		graphics handling, including *.eps* figures
helvet	scaled=0.83	sets helvetica as the default sans-serif font, with correct scaling to match the serif font size
hyphenat		improves spacing and breaking of hyphenated words
listings		enables the inclusion of high-quality computer code listings
mathptmx		changes fonts
nag		checks that packages are up to date and looks for bad habits in LaTeX code.
parskip		required for better spacing
pdfcomment		required for tool-tips. Also calls the `hyperref` package
setspace		required for better spacing
subfigure		provides the `subfigure` environment to produce sub figures
tocloft	subfigure	improved table of contents and list of figures/tables in memoir documents
tocbibind	nottoc, notlot, notlof	Add bibliography/index/contents to Table of Contents in memoir documents
todonotes		inline and margin to-do notes
xcolor		Driver-independent color extensions for LaTeX and pdfLaTeX

...
\tableofcontents
\clearpage
\listoffigures
\listoftables
\mainmatter
...
\backmatter
\end{document}

Page numbering in the front matter (i.e. the Abstract, Summary, and Foreword chapters or sections) starts at page 3 to allow for NREL cover pages.

If you don't use the `\frontmatter` commands, you may need to increment the page counter manually. To increment the counter *n* pages, use `\setcounter{page}{n}` after `\begin{document}`.

3.3.2 Cross references

Use labels and references to refer back and forth to figures, equations, tables and sections.

For example, an equation can be added using the following text:

\begin{equation}
y = mx+c
\label{eqn:line}
\end{equation}

This gives the following:

$$y = mx + c \tag{3.1}$$

And using the text `Eqn. \ref{eqn:line}` provides a cross reference to Eqn. 3.1.

3.3.3 Floats

Floats are images, tables or other pieces of the document that are free to move to the best place in the document for them. The two most common floats are the tabular environment (for tables) and the figure environment for figures.

3.3.3.1 Tables

Use the `tabular` environment to produce basic tables. Table 2 is produced using this code:

```
\begin{table}[!h]
\centering
\caption{An example table.}\label{tab:widgets}
\begin{tabular}{lr}
Item & Quantity \\
\hline
Widgets & 42 \\
Gadgets & 13
\end{tabular}
\end{table}
```

Table 2. An example table.

Item	Quantity
Widgets	42
Gadgets	13

If all of the delimiters (&) are included in each row, the table will be complete and will produce a better PDF.

Note that tables produced using the `tabular` and `tabular*` environments are automatically typeset in a sans-serif font which is similar to Arial. This is required by the NREL style guide.

3.3.3.2 Figures

To include a figure in a document, use the `figure` environment and the `includegraphics` command.

```
\begin{figure}
\includegraphics[width=\textwidth]{figure's-file-name}
\caption{Caption goes here.}\label{fig:figuresLabel}
\end{figure}
```

3.3.3.3 Subfigures

Subfigures are implemented using the `subfig` package. The example below generates Figure 1.

```
\begin{figure}
\centering
\hfill
\subfigure[Wind turbines at the Forward Wind Energy Center in Fond du Lac and Dodge Counties, Wisconsin. (
    Photo by Ruth Baranowski / NREL) \label{fig:21206}]{\includegraphics[height=2.5in]{files/21206}}
~
\hfill
\subfigure[Aerial view of the National Wind Technology Center. (Photo by Dennis Schroeder / NREL)\label{fig
    :20018}]
```

{\includegraphics[height=2.5in]{files/20018}}
\hfill
\caption{NREL images}**\label**{fig:NRELimages}
\end{figure}

(a) Wind turbines at the Forward Wind Energy Center in Fond du Lac and Dodge Counties, Wisconsin. (Photo by Ruth Baranowski / NREL)

(b) Aerial view of the National Wind Technology Center. (Photo by Dennis Schroeder / NREL)

Figure 1. NREL images

3.3.4 Citations

Use `bibtex` to organize references and store them in a single file (e.g. `/Documents/bibliography/bibliography.bib`). The bibliography will then contain entries with 'keys' for each source, like `Lamport_1986_a`.

Authors can then insert citations to this key throughout their document, using different styles of citation. Citations are generated using the `biblatex` package, which also formats references in the correct style. Ways to generate citations are described in the `biblatex` documentation, and include:

- `\cite{Lamport_1986_a}` prints Lamport 1986.
- `\citep{Lamport_1986_a}` prints (Lamport 1986).
- `\citet{Lamport_1986_a}` prints Lamport (1986).

To cite URLs, use the 'misc' style. For example, the bibtex entry for http://tex.stackexchange.com Anon. 2014 looks like this:

@misc{texstackexchange,
Author = {Anon.},
Howpublished = {Accessed July 21, 2014: \url{http://tex.stackexchange.com}},
Title = {**TeX** −− LaTeX Stack Exchange},
Year = {2014}}

This format will allow you to include the date on which a URL was accessed.

The citations should work with journal articles (Clifton et al. 2013), books (Knuth 1984; Lamport 1986; "The Chicago Manual of Style" 1982), technical reports (Other and Nother 2014), and URLs (Anon. 2014). Any unknown publication types will be formatted using the 'misc' type.

3.3.5 Including computer code

The `listings` package has been loaded. Note: this does not work if the 'Draft' document option is used.

To change the syntax highlighting use `\lstset{language=[dialect]language,columns=fullflexible,keepspace` before each listing where the language changes. For more details see the `lstlisting` documentation.

3.3.6 NREL-style bibliographies

NREL uses "Chicago A" style-references. The *nrel.cls* file uses Biblatex to produce these references automatically.

To include a bibliography in the document give the bibliography file location in the preamble, and insert the bibliography at the appropriate location:

% give the bibliography file location
\bibliography{files/bibliography.bib}
...
\begin{document}
...
% insert the bibliography into the document
\cleardoublepage
\label{sec:Bib}
\printbibliography
...
\end{document}

An example bibliography is included in this document on page 13.

3.4 Creating a file structure

Your main file should be called *main.tex*. This helps editors and coauthors identify where to start. Then, use `input` to import other files into your main file at compilation.

For example, each of the chapters in this report is in separate files, called *WhatIsLatex* (Chapter 1), *NRELRequirements.tex* (Chapter 2), *LatexAtNREL.tex* (Chapter 3), and so-on. In the example available on Github, they are stored in the *files* directory. *main.tex* then looks like this:

...
\begin{document}
% content
\input{files/WhatIsLatex}
\input{files/NRELRequirements}
\input{files/LatexAtNREL}
...

3.5 Best practice in writing a document in LaTeX

Create a structure before you get too far. Authors will find it easier to write documents and make changes if they separate the content of the document from the structure.

1. Each new LaTeX document should be placed in it's own directory.
2. Create a main LaTeX file that just contains the preamble, custom commands and uses `input` to call the content. See Section 3.4 for an example where each `chapter` is contained in its own file. In an article, each `section` could be contained in its own file.

3. Keep the number of packages used to a minimum. If authors feel that something is desperately missing, they can contact the maintainers of the *nrel.cls* file. Not all packages can be used as they lack compatibility.

Focus on content, not appearance. Don't spend hours trying to adjust fonts, headers or spacing between lines.

1. The document produced should meet NREL's requirements if it is compiled using *nrel.cls*.
2. Don't throw in lots of `clearpages` or other commands to push material around. LaTeX is designed to handle that.
3. Resist the temptation to add or subtract space, change lengths or do other things to modify the layout.
4. Write!

4 Preparing a high-quality PDF from LaTeX

If the author chooses to complete the publications process using LaTeX the author must incorporate feedback and edits in to the LaTeX source files and prepare the final PDF, following these guidelines.

4.1 PDF tagging

PDF tagging is a process whereby the components of the PDF document (headings, figures, tables, text) are marked so that a document reader can understand the document. This is useful when text to speech converters are being used. The process of tagging is also known as structuring, so that a tagged document might also be referred to as a structured document.

LaTeX does not prepare a tagged PDF document. The current solution to this is to use the tagging capability built in to Adobe's Acrobat Pro.

4.2 Embedded fonts

NREL requires that all fonts be embedded in the the final PDF. Check the PDF for embedded fonts using a PDF viewer. For example, in Adobe Acrobat Reader, look at the 'fonts' tag of the document properties. If any fonts are not shown as being an *embedded subset*, try the conversion again.

Encapsulated postscript figures are particularly prone to having undefined fonts. Check by compiling the document in draft mode, and seeing if the fonts are still present in the output PDF. To fix this problem, change *.eps* files to *.png* files. To do this 'on the fly', use this in the document's preamble:

```
\usepackage{epstopdf}
\epstopdfDeclareGraphicsRule
 {.eps}{png}{.png}{convert eps:\SourceFile.\SourceExt png:\OutputFile}
\AppendGraphicsExtensions{.png}
```

References

Anon. 2014. *TEX– LATEXStack Exchange*. Accessed July 21, 2014: http://tex.stackexchange.com.

Clifton, A., et al. 2013. "Using machine learning to predict wind turbine power output". *Environmental Research Letters* 8 (2): 024009. doi:10.1088/1748-9326/8/2/024009.

Knuth, Donald E. 1984. *The TEXbook*. Addison-Wesley.

Lamport, Leslie. 1986. *LATEX: A Document Preparation System*. Addison-Wesley.

Other, A. N., and Y. A. Nother. 2014. *A technical report*. Tech. rep. National Renewable Energy Laboratory.

"The Chicago Manual of Style". 1982, Thirteenth, 400–401. University of Chicago Press.