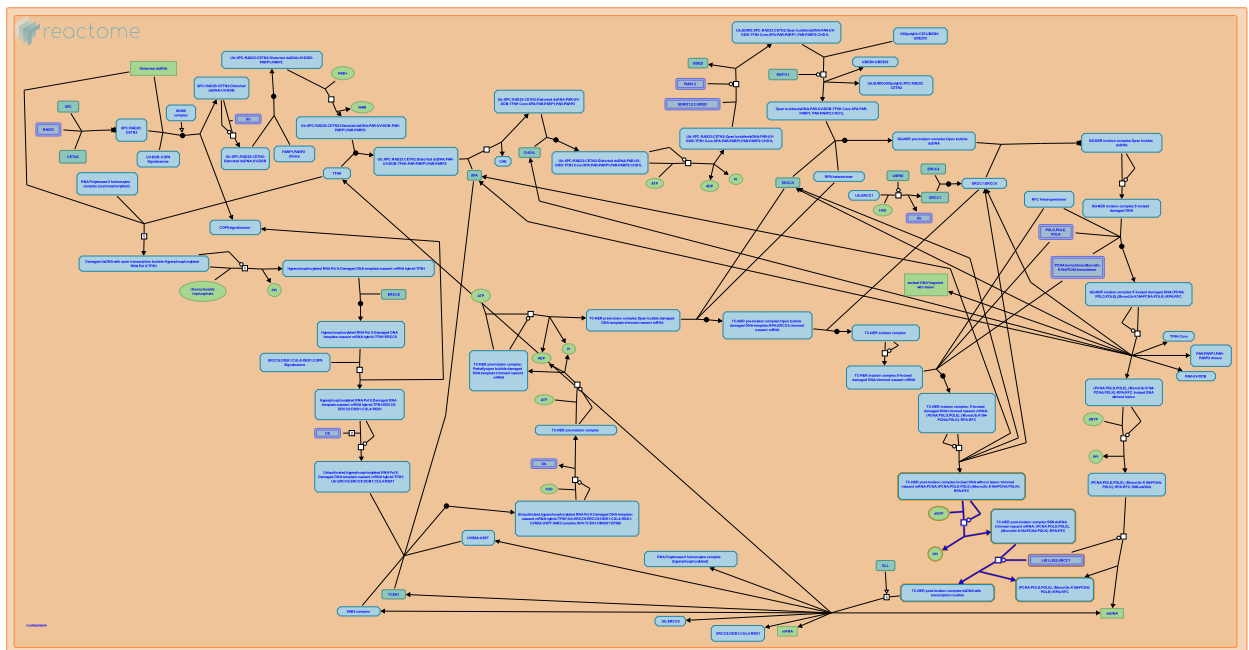


# Gap-filling DNA repair synthesis and ligation in TC-NER



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This is just an excerpt of a full-length report for this pathway. To access the complete report, please download it at the [Reactome Textbook](https://reactome.org/textbook).

05/05/2024

## Introduction

Reactome is open-source, open access, manually curated and peer-reviewed pathway database. Pathway annotations are authored by expert biologists, in collaboration with Reactome editorial staff and cross-referenced to many bioinformatics databases. A system of evidence tracking ensures that all assertions are backed up by the primary literature. Reactome is used by clinicians, geneticists, genomics researchers, and molecular biologists to interpret the results of high-throughput experimental studies, by bioinformaticians seeking to develop novel algorithms for mining knowledge from genomic studies, and by systems biologists building predictive models of normal and disease variant pathways.

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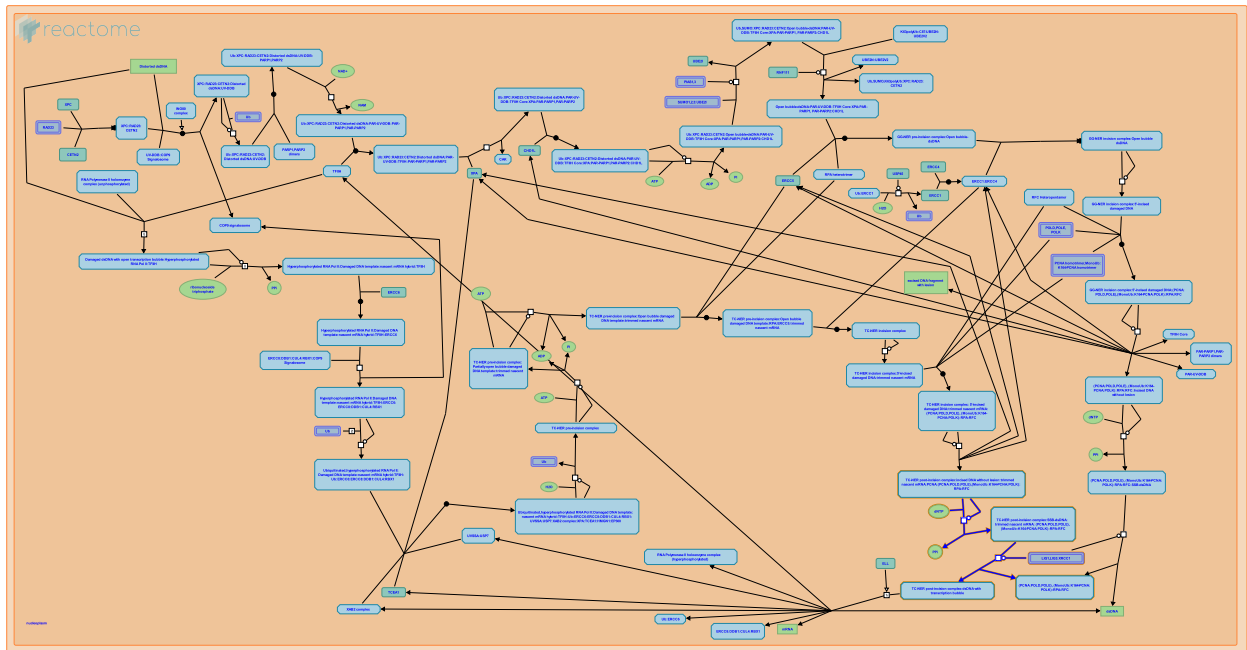
Reactome database release: 88

This document contains 1 pathway and 2 reactions ([see Table of Contents](#))

# Gap-filling DNA repair synthesis and ligation in TC-NER ↗

**Stable identifier:** R-HSA-6782210

**Compartments:** nucleoplasm



In transcription-coupled nucleotide excision repair (TC-NER), similar to global genome nucleotide excision repair (GG-NER), DNA polymerases delta or epsilon, or the Y family DNA polymerase kappa, fill in the single stranded gap that remains after dual incision. DNA ligases LIG1 or LIG3, subsequently seal the single stranded nick by ligating the 3' end of the newly synthesized patch with the 5' end of incised DNA (Staresincic et al. 2009, Ogi et al. 2010, Arakawa et al. 2012, Paul-Konietzko et al. 2015).

## Literature references

Limsirichaikul, S., Takenaka, K., Yamashita, S., Cloney, R., Lehmann, AR., Miki, Y. et al. (2010). Three DNA polymerases, recruited by different mechanisms, carry out NER repair synthesis in human cells. *Mol. Cell*, 37, 714-27. ↗

Arakawa, H., Paul-Konietzko, K., Iliakis, G., Thomale, J. (2015). DNA Ligases I and III Support Nucleotide Excision Repair in DT40 Cells with Similar Efficiency. *Photochem Photobiol*, 91, 1173-80. ↗

Arakawa, H., Bednar, T., Wang, M., Mladenov, E., Bencsik-Theilen, AA., Iliakis, G. et al. (2012). Functional redundancy between DNA ligases I and III in DNA replication in vertebrate cells. *Nucleic Acids Res*, 40, 2599-610. ↗

Wijgers, N., Staresincic, L., Schärer, OD., Gourdin, AM., Fagbemi, AF., Enzlin, JH. et al. (2009). Coordination of dual incision and repair synthesis in human nucleotide excision repair. *EMBO J.*, 28, 1111-20. ↗

## Editions

2004-01-29	Authored	Hoeijmakers, JH.
2015-06-16	Authored, Edited, Revised	Orlic-Milacic, M.
2015-08-03	Reviewed	Fousteri, M.
2024-02-22	Edited	Orlic-Milacic, M.

## Repair DNA synthesis of ~27-30 bases long patch by POLD, POLE or POLK in TC-NER

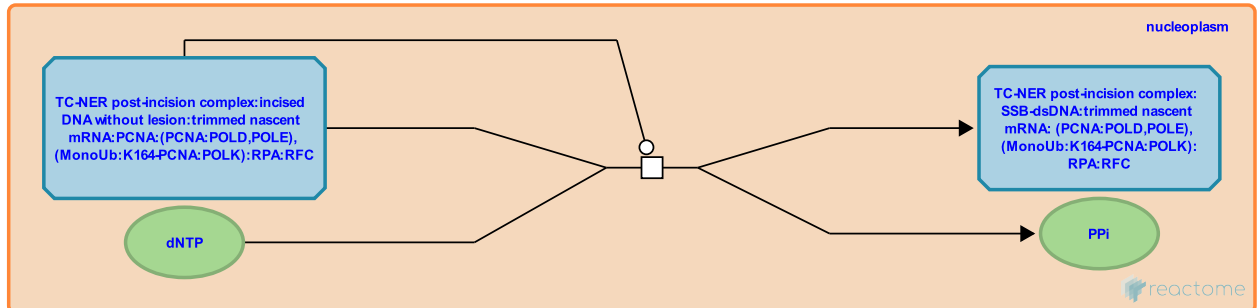


**Location:** Gap-filling DNA repair synthesis and ligation in TC-NER

**Stable identifier:** R-HSA-6782208

**Type:** transition

**Compartments:** nucleoplasm



In transcription-coupled nucleotide excision repair (TC-NER), as well as in global genome nucleotide excision repair (GG-NER), the DNA synthesis complex (NER post-incision complex) consisting of PCNA, RPA, RFC and polymerase delta (POLD) or epsilon (POLE) complexes performs DNA repair synthesis after the damaged DNA strand is incised 5' to the lesion by the endonuclease complex ERCC1:ERCC4 (ERCC1:XPF) and 3' to the lesion by the endonuclease XPG (ERCC5). Depending on damage-induced PCNA monoubiquitination, DNA polymerase kappa (POLK) may also be involved in gap-filling DNA synthesis during nucleotide excision repair (NER) (Balajee et al. 1998, Staresincic et al. 2009, Ogi et al. 2010, Overmeer et al. 2011).

**Followed by:** Ligation of newly synthesized repair patch to incised DNA in TC-NER

### Literature references

Limsirichaikul, S., Takenaka, K., Yamashita, S., Cloney, R., Lehmann, AR., Miki, Y. et al. (2010). Three DNA polymerases, recruited by different mechanisms, carry out NER repair synthesis in human cells. *Mol. Cell*, 37, 714-27. [↗](#)

Bohr, VA., Dianova, I., Balajee, AS., May, A. (1998). Efficient PCNA complex formation is dependent upon both transcription coupled repair and genome overall repair. *Mutat. Res.*, 409, 135-46. [↗](#)

Fousteri, M., Mullenders, LH., Volker, M., Moser, J., Kool, H., van Zeeland, AA. et al. (2011). Replication protein A safeguards genome integrity by controlling NER incision events. *J. Cell Biol.*, 192, 401-15. [↗](#)

Wijgers, N., Staresincic, L., Schärer, OD., Gourdin, AM., Fagbemi, AF., Enzlin, JH. et al. (2009). Coordination of dual incision and repair synthesis in human nucleotide excision repair. *EMBO J.*, 28, 1111-20. [↗](#)

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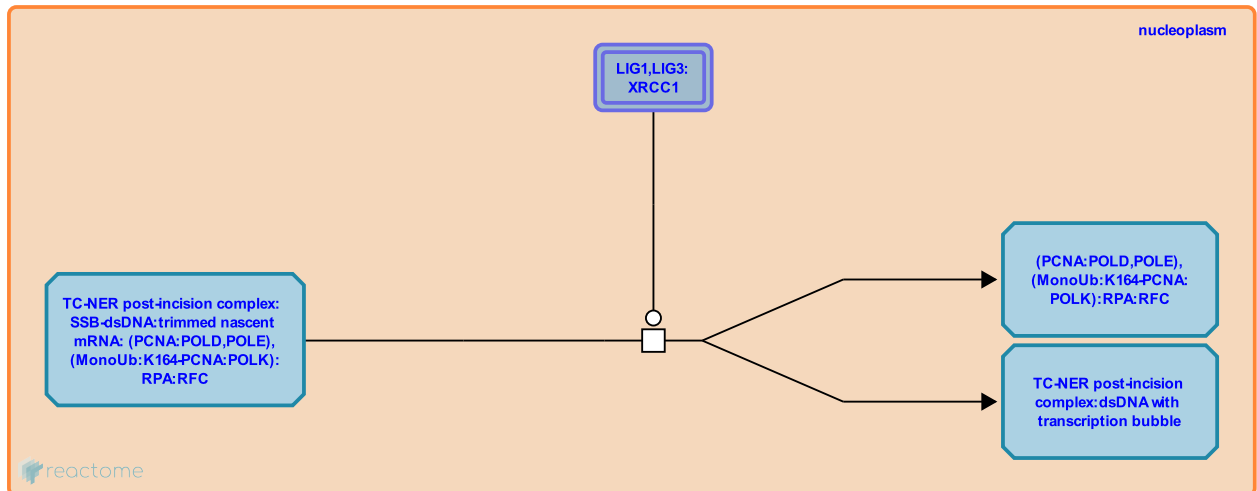
## Ligation of newly synthesized repair patch to incised DNA in TC-NER ↗

**Location:** Gap-filling DNA repair synthesis and ligation in TC-NER

**Stable identifier:** R-HSA-6782227

**Type:** transition

**Compartments:** nucleoplasm



The nucleotide excision repair (NER) is completed when the newly synthesized fragment is ligated to the incised DNA strand, thus sealing the single stranded nick (SSB). Two DNA ligases, *LIG1* and *LIG3*, can perform the ligation in transcription-coupled NER (TC-NER), as well as in global genome NER (GG-NER) (Arakawa et al. 2012, Paul-Konietzko et al. 2015).

**Preceded by:** Repair DNA synthesis of ~27-30 bases long patch by *POLD*, *POLE* or *POLK* in TC-NER

### Literature references

Arakawa, H., Paul-Konietzko, K., Iliakis, G., Thomale, J. (2015). DNA Ligases I and III Support Nucleotide Excision Repair in DT40 Cells with Similar Efficiency. *Photochem Photobiol*, 91, 1173-80. ↗

Arakawa, H., Bednar, T., Wang, M., Mladenov, E., Bencsik-Theilen, AA., Iliakis, G. et al. (2012). Functional redundancy between DNA ligases I and III in DNA replication in vertebrate cells. *Nucleic Acids Res*, 40, 2599-610. ↗

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