A GUIDE TO PRODUCING STEMS

1. Context

This document is intended for composers/producers who wish to send a set of stems, rather than a final mix, to a mastering studio. This technique lets the engineer make optimal use of reference acoustic and audio tools in the mastering studio, and allows for the focussed treatment of those portions of the audio that are in need of correction.

The mastering studio receives a set of synchronized stereo or multichannel tracks, each containing an entirely premixed subgroup of tracks, also called *stems*. The original mix is exactly reconstructed by syncing each of these subgroups to a single reference point in time, reproducing all at unity gain. The engineer may then treat each of the track groups separately, each intervention now being less prejudicial to the ensemble while permitting more in depth work.

The mastering engineer never attempts to do the work of the mixer. His actions are restricted to precise interventions in a manner that does not affect the entire mix. In the past, situations would arise where, for example, the equalization of a voice which was too piercing could lead to the dulling of a guitar which had been well mixed, but close to the voice in the frequency domain: in this case, one can now intervene uniquely on the voice, which permits the conservation of a larger proportion of the original mix.

2. Preparation

2.1 Finish the mix

Mix your piece exactly as you want it to be heard, with the absolute maximum volume between -1 dB and -0.5 dB, without using a limiter at the master output. In fact, with the exception of master volume automation, which will have to stay "on" throughout the whole process, avoid at all cost applying effects to the "master" output. It is not a good idea to use processing at the master level, since most of the available compression and EQ plug-ins do not offer sufficiently good audio quality for a final mix.

There are exceptions, however, but these are professional tools, with dozens of controls. Placed in the wrong hands, such tools could very easily completely destroy a mix.

Along the same line, and worth mentioning:

○ All effects that are input level dependent – compressors, analog equipment emulators, etc. – should be applied only at the track level. That said, and using caution (see 3.2), EQ and effects send can be performed at the sub-group level, even if elements of the sub-group are meant to be exported to different stems;

○ If the piece needs a global reverb, it is best to apply the effect track-by-track or to subgroups – varying the parameters governing the distance of the virtual source. This will always give cleaner results than applying the effect just once to the entire mix.

2.2 Produce a Reference File

When you have finished mixing, create a 32-bit float, stereo/multichannel, AIFF/WAV file (interleaved, if possible), without changing the sampling rate of your session. If 32 bit is unavailable, 24 will be fine. This will serve as a reference during mastering, ensuring that the sum of your stems exactly reconstructs your mix.
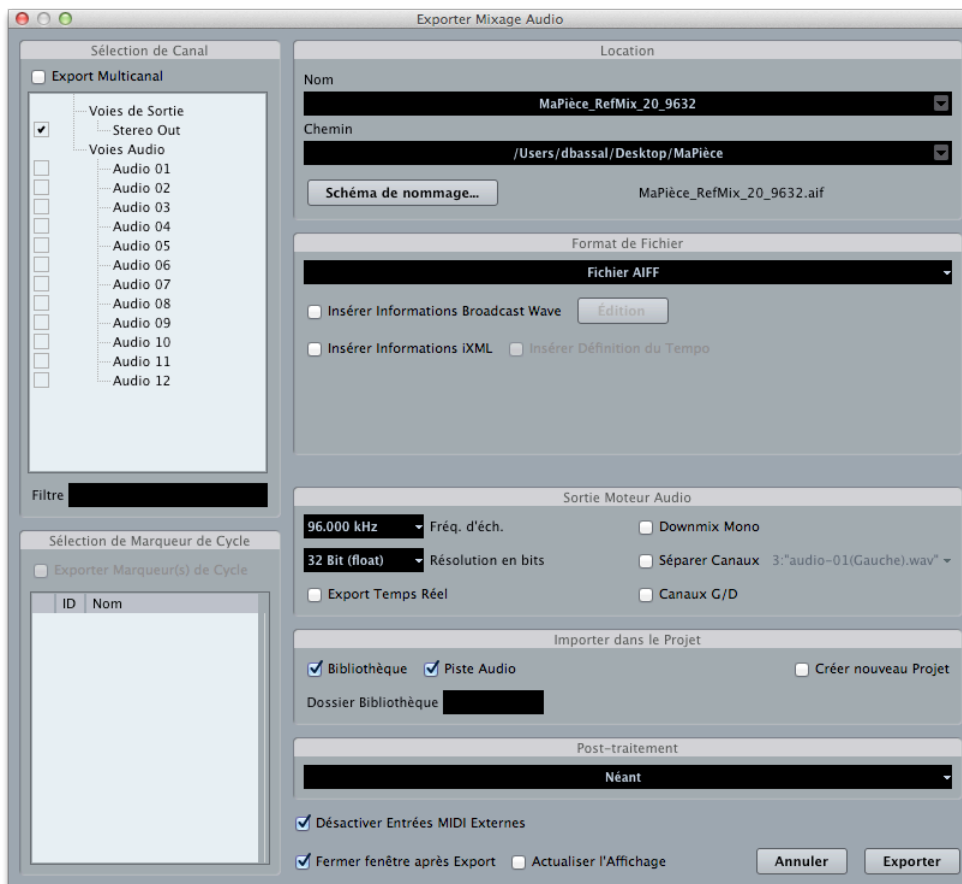

Fig 1
The screen capture opposite, as with all others in this document, comes from the Mac OSX version of Nuendo 6.0.6. It is shown here only for illustration: the terminology, along with the exact display, will of course be different in other hardware/software configurations.

This window illustrates the proper settings for generating a reference mix, but it is equally applicable to the production of individual stems, as we will see later. The sample rate in this session is 96 kHz; the mix will be exported at this sample rate in order to minimize digital manipulations, which create approximations in calculations, and thus distortion.

2.3 Organizing the Stems

Returning to your session, and without changing a single parameter, listen to your piece to determine how will your audio material will be organized, in other words: how many stems you will need,. Remember that a stem is easiest to use in mastering when its frequency content and distribution of audio elements over time is as "isolated" as possible. Typically, 8 stereo stems are enough for adequate separation. Sometimes you will be able to use fewer, and sometimes you will need more. The absolute maximum is 12.

An analogy to follow for building stems could be taken from pop songs:

◎ The lead vocal should be alone on a stem, its reverbs / delays on another;

◎ All backup vocals are on another stem;

◎ The drums are separated into at least four stems: kick, snare, cymbals, and toms;

◎ The bass is obviously alone;

◎ If there are many guitars, group them by type of sound / playing: distortion, muffled, airy chorus, rhythm, etc. Solos go on separate stems;

◎ Same for keyboards: pads are to be separated, if possible, from the more percussive sounds.

In electroacoustic music, processing can be so extreme that tracks built upon a unique source can end up gathering very different sounding materials. In this context, such tracks can no longer be used as the basic units to build stems. We will have to rely on blocks of sounds, that could be picked up from different tracks, and regrouped as such, for example:

◎ Bass and deep bass content – long sounds;

◎ Bass and deep bass content – short sounds;

◎ Pads – high mids & highs;

◎ Pads – low mids and lows;

◎ Scratches, aggressive sounds based on high frequencies;

◎ Scratches, aggressive sounds based on mid frequencies;

◎ Transients, clicks;

◎ Reverbs.

The criteria for the distribution of audio elements over time are equally important. Sound events separated by silences are always easier to work with than uninterrupted stems. Consider the case of two sonic units, each with different frequency content; even if they respond to each other through successive cross-fades, each of these units should be on a different stem.

3. Procedure

3.1 Isolating the Stem

Do not isolate tracks by soloing them:

◎ Certain DAWs/mixers raise the gain of a soloed track, sometimes even by a programmable amount;

◎ Other DAWs/mixers automatically set the track centre-mono;

◎ There are also cases where all of the effects linked to the track are automatically muted.

A safer method is to mute each track which will <u>not</u> be part of the stem.

3.2 Verifying the Effects Routing

In certain configurations, effects in "pre-fader" mode don't take account of the fact that the track that feeds them has been muted! If this is the case with your software, remember to block the effects "send" on each track that you are muting!

3.3 Determining the Length of the Stem

You should now determine the length of the stem. Each stem must begin from time zero, even if the first sound on it is in the middle of the piece! It must also continue without interruption until there are no more sounds on it. It may seem absurd to produce an audio file that begins with three minutes of silence, followed by 20 seconds of sound, followed by two further minutes of silence. But perfect re-synchronization of your stems requires that they all begin at time zero. You can, however, cut a stem short at the point where it contains no more sound.
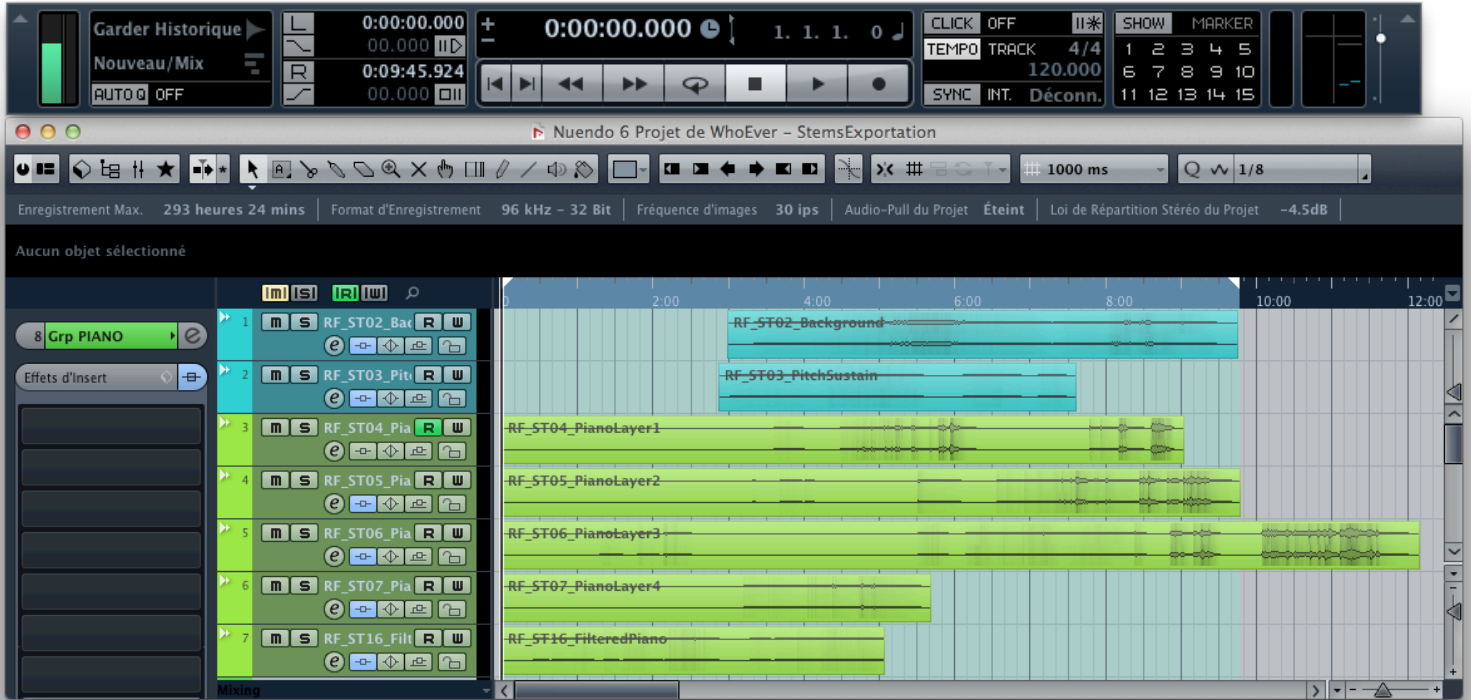
Fig 2 For this piece, of total duration exceeding 12 minutes, the stem being exported regroups the first two tracks, *Background* and *PitchSustain*. Audio begins a little before 3 min, and completely stops at 9:46

In the upper window, we can see that the section being exported begins regardless at 0:00:00.000 (indicated right of the "L"), and finishes at 0:09:45.924 (right of the "R").

Here, the length of the stem is confirmed, in the main window, by the pale blue background of the selected section.

3.4 Generating the Stems

The rules for generating stems are the same as those in **Fig 1**: same sample rate as the session, 32 or 24-bit resolution, AIFF/WAV interleaved stereo/multichannel file. Use a naming system that is understandable and systematic, and export the first stem. It would be best to listen to this entire first stem, to make sure that everything is correct.

If all seems in order, we can now proceed to the next stem. One way to do this is to mute the tracks/blocks which have just been used, and then to unmute those which will be used in the subsequent stem. But this way of proceeding is prone to error: we may forget about one element, or include the same element in a number of stems. The method proposed here helps avoid both omissions and duplications:

◎ Copy and rename the file containing the mix, carry out the steps below on this copy;

◎ After generating the first stem as described above, delete all of the elements that make up the stem;

◎ Activate the elements which will be part of the second stem, along with any control tracks related to these elements;

◎ Generate the second stem, delete the corresponding elements, and proceed in this way until the final stem has been produced. With this method, it is easy to see which elements have not yet been included in a stem.

Once all the stems have been generated, do a final verification to confirm that nothing has been omitted. Create a new session in your DAW, and import first the reference mix (section **2.2**), and then all of the stems that you produced. All of these elements must be lined up to begin at time 0:00:00.000. Make sure that each stereo pair is correctly set to **full pan** (hard left/hard right), and that each track is at unity gain, by deactivating automation and setting all faders on the mixer to 0 dB. Then compare, in blocks of 15-20 seconds, the reference mix with the sum of all the stems. These should sound exactly the same, and have identical average and peak output levels.

4. Delivery

If necessary, write up an explanatory text, in Word or TextEdit, to make the mastering engineer's work easier. Explain any deviations from the procedure described here that you may have found necessary: organization of stems, alternative versions, mono stems, etc. You might wish to describe aesthetic goals clearly and practically, but try to restrict yourself to audio terminology. Any request for a particular "sonic signature" should be explained as soberly as possible: *"Please make the link between the ecological inspiration in the introduction and the urban planning of the city of Khartoum more vague"* risks producing less tangible results than *"Please enlarge the stereo image only in the high frequencies."*

Finally, deliver all of the stems accompanied by the reference mix to the mastering studio, preferably by ftp. Free and easy FTP client software are downloadable here:

Mac: http://cyberduck.en.softonic.com/mac   PC: http://cyberduck.en.softonic.com

Specific questions about the content of this document can be sent by email to the author, at the following address: dominique.bassal@videotron.ca

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